



Survey of Fusarial wilt of Chilli (*Capsicum annum* L.) caused by *Fusarium* spp. in south Gujarat

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Abstract:

Chilli (*Capsicum annum* L.) is one of the most important vegetable and spices crop grown across the world for the value for its valuable fruits and is popularly known as “red pepper” which belongs to night shade family Solanaceae. During the survey on chilli wilt disease occurrence, the symptoms observed on chilli infected plants were yellowing and brown vascular discoloration of plants, dried foliage and dead wilted plants. It was noticed that in all the surveyed villages of Bharuch district the disease was at peak and severely affected chilli crops from flowering to fruiting stage of crop especially during the month of November-December. Overall, 58.49 per cent disease incidence was recorded in the Bharuch district. The highest 70 per cent and lowest 24 per cent PDI was recorded in Valia and Bharuch taluka, respectively. PDP was also recorded highest 66.67 and lowest 20 per cent in Valia and Bharuch taluka, respectively.

Key words: Chilli, *Fusarium* spp., survey, wilt, south Gujarat, purification

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Introduction

Chilli is considered as one of the most important vegetable and spices crop grown in world and is popularly known as “red pepper”. The Scientific name of Chilli is *Capsicum annum* L. which belongs to nightshade family Solanaceae. Capsicum is a Greek word derived from “Kapisino” meaning “to bite” (Anonymous2009). It is commonly known as mirchi, hot pepper, garden pepper, salad pepper, paprika, bell pepper, red pepper, capsicum, pod pepper, etc. It is believed to be originated around 7500 BC in Mexico. In India, it was introduced by Portuguese during end of 15th century in Goa. It is an often cross-pollinated annual herb having diploid chromosome number $2X = 24$. The five cultivated species of capsicum are *C. annum*, *C. frutescens*, *C. chinense*, *C. baccatum* and *C. pubescens*. In India, *C. annum* and *C. frutescens* is the most commercially cultivated species of capsicum (Bose *et al.*2002).

In 1919, Leonian first time reported Fusarium wilt disease of chilli and named the pathogen as *Fusarium*. The most common species reported in India are *Fusarium annum*, *Fusarium oxysporum* and *Fusarium solani*. *Fusarium* disease occurs in almost all chilli growing areas of India causing



major yield and quality loss. The estimated seedling mortality caused by *F. oxysporum* and *F. solani* recorded were 56 per cent and 36 per cent, respectively, Liang (1990). The disease incidence was recorded as high as 2-85 per cent while yield loss varied from 10 – 80 per cent (Loganathan *et al.* 2013). At 28°C, the growth of pathogen is maximum, Cook and Baker (1983).

The conditions favourable for pathogen are dry weather condition and presence of excessive moisture in soil. The major characteristic symptoms caused by the disease are brown vascular discoloration followed by inward rolling of the upper leaves and subsequently wilting of the plant, Rivelli (1989). The wilting symptoms appear to be a result of severe water stress, mainly due to vessel occlusion by production of gel, gum and tyloses and vessel crushing by proliferation of adjacent parenchyma cells, Beckman (1987). The plants become permanently wilted within a few days and the dried foliage remains attached to the plant (MacHardy and Beckman 1981; Rivelli 1989).

Materials and Methods

Survey of chilli fusarial wilt (*Fusarium* spp.) in different villages of Bharuch district of Gujarat

The survey was conducted in the various chilli growing regions of different villages of Bharuch district in South Gujarat (Table 1) during *Rabi* season. The method adopted for the survey was random roving survey method (Raghu *et al.* 2016) in which the villages were selected based on cultivated areas of chilli and severity of wilt disease in the area was recorded. During the survey 50 plants were selected from each infected field. From which the total number of infested plants were counted to calculate the per cent disease incidence. The geographical location and altitude of the farmer's field which was surveyed was noted using GPS.

Table 1: Different villages of Bharuch district surveyed during the experiment

District	Taluka	Village
Bharuch	Valia	Vadfaliya
		Deli
		Bhamadiya
		Boria
		Avadar
	Netrang	Moja
		Zarana
		Baldva
		KoyaliMandvi
	Jagadiya	Atkol
		Govali
		Nana sanja
		Sultanpura
	Bharuch	Jagadiya
		Limodara
		Kabirvad
		Mangaleshvar
Nikora		
Tavara		
Shukaltirth		

Collection of sample

From the 50 plants surveyed from each field, 5 plants showing wilting symptoms *viz.*, yellowing and wilting in younger leaflets, epinasty, stunting and yellowing of older leaves, brown vascular



discoloration of the collar portion of plants were collected as the representative sample for further microscopic investigation.

Observations Recorded

Systematic symptom development of infected plants was observed and recorded. Presence of pathogen was recorded with + ve and – ve sign.

Percent disease prevalence was calculated by using the formula:

$$\text{Per cent disease prevalence} = \frac{\text{Number of Infested field observed}}{\text{Total number of fields observed}} \times 100$$

Per cent disease incidence was calculated by using the formula:

$$\text{Per cent disease incidence} = \frac{\text{Total Number of Infected plants}}{\text{Total number of plants observed}} \times 100$$

Isolation, Purification and Identification of *Fusarium* spp.

The collected infected samples were subjected through microscopy and positive (+) samples were subjected to isolation using tissue isolation technique. The pathogen *Fusarium* spp. was isolated from the freshly infected collar portion of the plant. After the development of fungal colony, a small bit of single mycelium was transferred on another petri-plate containing PDA medium to obtain pure culture. This pure culture was maintained in PDA slants for further studies. The growth of pathogens was subjected to microscopy and their sporulation was observed. On the basis of morphological and cultural characteristics developed by the pathogen, identification was done up to genus level. The subsequent culturing was performed throughout the investigation (Bai *et al.*2018).

Result and Discussion

Survey of chilli fusarial wilt (*Fusarium* spp.) in different villages of Bharuch district of Gujarat

A random roving survey was conducted in various chilli growing areas of Bharuch district, Gujarat during 2020-21. During the investigation, 20 villages of 4 different talukas of Bharuch district were surveyed and the information regarding sampling locations was noted using GPS which have been furnished in the Table 2. The information regarding the soil type and crop growth stages i.e., seedling stage, flowering stage and fruiting stage of the surveyed location collected during the survey from each village have also been presented in Table 2. The maximum disease incidence was observed during the fruiting stage of the crop as compared to other stages. Twenty isolates obtained during the survey have been shown in Table 2.

The symptoms observed during the survey on infected plants were yellowing and brown vascular discoloration of plants. The upper leaves were rolled inward and the growth of infected plants was also stunted as compared to the healthy ones. Appearance of water-soaked lesions on the root and



stems also indicated diseased infection in plants. The foliage portion was also dried and wilted causing death of plant. These symptoms showing infected plants were collected and subjected to further studies.

From the data collected during the survey, the per cent disease incidence was calculated which have been tabulated in the Table 3 and graphically illustrated in Figure 1. The overall PDI recorded for Bharuch district was 58.49 per cent. From the four talukas, the maximum PDI of 70 per cent was recorded for the Valia taluka followed by 66.13 per cent for Jagadiya and 59.16 per cent for the Netrang taluka of Bharuch district. While the minimum PDI 38.66 per cent was recorded for the Bharuch taluka. The highest PDI 88 per cent and the lowest PDI 24 per cent was recorded for the Vadfaliya village of Valia taluka and Nikora village of Bharuch taluka, respectively.

The details regarding the perusal of data, the per cent disease prevalence have been depicted in Table 3 and graphically represented in Figure 1. The result indicated that maximum 66.67 per cent PDP was recorded in the Valia taluka while, the minimum 20 per cent PDP was recorded in the Bharuch taluka. Among the twenty villages surveyed, the five village viz., Deli, Avadar, Koyali mandvi, Limodara and Nikora villages recorded 100 per cent PDP. While zero per cent disease prevalence was recorded in Shukaltirth, Kabirvad, Mangaleshvar and Tavera villages of the Bharuch taluka. The results obtained were found in accordance with the findings of Wani *et al.* (2014) where the disease incidence was recorded maximum during the flowering stage and highest 40.36 per cent disease incidence was recording during the survey of Kulugam district of Kashmir valley.

Table 2: Survey of chilli Fusarial wilt disease in different villages of Bharuch district and their relative information

District	Taluka	Village	Isolates	Crop Stage	Soil Type	Longitude	Latitude
Bharuch	Valia	Vadfaliya	BVV-1	Fruiting	Black soil	21.562161	73.209053
		Deli	BVD-1	Flowering	Loamy Sand	21.562189	73.209080
		Bhamadiya	BVBh-1	Fruiting	Black Soil	21.527255	73.246206
		Boria	BVBo-1	Fruiting	Loamy Sand	21.526065	73.247013
		Avadar	BVA-1	Seedling	Medium Black Soil	21.628897	73.089066
	Netrang	Moja	BNM-1	Fruiting	Black Soil	21.552325	73.344956
		Zarana	BNZ-1	Fruiting	Medium black Soil	21.578634	73.336129
		Atkol	BNA-1	Fruiting	Black Soil	21.576422	73.342463
		Baldva	BNB-1	Fruiting	Black Soil	21.607192	73.391912
		KoyaliMandvi	BNK-1	Fruiting	Sandy Loam	21.582586	73.383423
	Jagadiya	Govali	BJG-1	Fruiting	Medium Black Soil	21.703512	73.095576
		Sulatnpura	BJS-2	Fruiting	Black soil	21.688384	73.098570
		Nana sanja	BJNs-1	Fruiting	Black soil	21.708905	73.099331
		Jagadiya	BJJ-1	Fruiting	Sandy Loam	21.732275	73.142584
		Limodara	BJL-1	Fruiting	Black Soil	21.732276	73.142583
	Bharuch	Shukaltirth	BBS-1	Seedling	Black soil	21.751442	73.107162
		Kabirvad	BBK-1	Seedling	Black Soil	21.748691	73.107722
		Mangaleshvar	BBM-1	Fruiting	Black Soil	21.748739	73.107922
		Tavera	BBT-1	Fruiting	Black Soil	21.7400000	73.0612607
		Nikora	BBN-2	Seedling	Loamy Soil	21.782910	73.133522



Table 3: Evaluation of chilli Fusarial wilt disease severity in the different villages of the Bharuch district

District	Taluka	Village	Isolates	PDI (%)	PDP (%)	Pathogen (+/-)
Bharuch	Valia	Vadfaliya	BVV-1	88.00	50.00	+
		Deli	BVD-1	78.00	100.00	+
		Bhamadiya	BVBh-1	52.00	33.33	-
		Boria	BVBo-1	56.00	50.00	-
		Avadar	BVA-1	76.00	100.00	-
		Mean		70.00	66.67	
	Netrang	Moja	BNM-1	70.00	33.33	+
		Zarana	BNZ-1	60.00	33.33	-
		Atkol	BNA-1	60.66	66.66	+
		Baldva	BNB-1	46.00	40.00	+
		KoyaliMandvi	BNK-1	53.33	100.00	-
		Mean		59.16	54.66	
	Jagadiya	Govali	BJG-1	79.33	60.00	+
		Sulatnpura	BJS-2	66.00	50.00	+
		Nana sanja	BJNs-1	62.00	50.00	+
		Jagadiya	BJJ-1	72.00	50.00	-
		Limodara	BJL-1	51.33	100.00	-
		Mean		66.13	62.00	
	Bharuch	Shukaltirth	BBS-1	63.33	0.00	-
		Kabirvad	BBK-1	44.00	0.00	-
		Mangaleshvar	BBM-1	32.00	0.00	-
		Tavara	BBT-1	30.00	0.00	-
		Nikora	BBN-2	24.00	100.00	-
		Mean		38.66	20.00	
	Overall Mean				58.49	

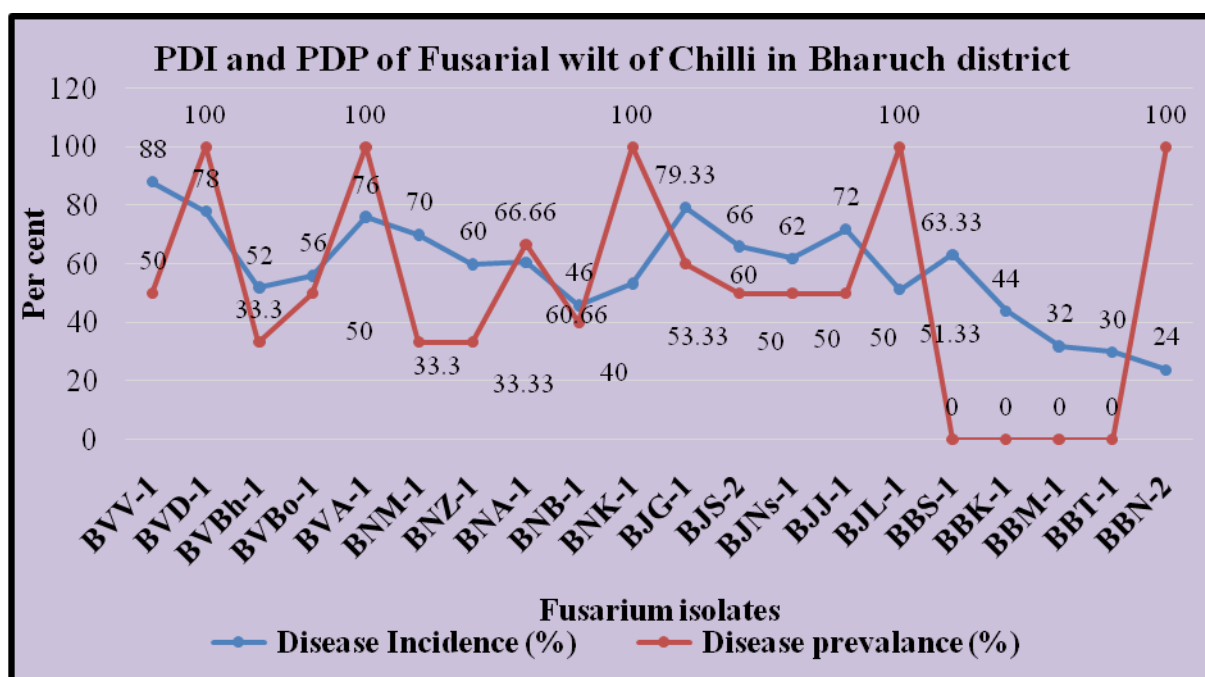




Fig. 1 Evaluation of Chilli Fusarial wilt disease severity in the different villages of the Bharuch district

Isolation, Purification and Identification of *Fusarium* spp.

The infected samples collected from the surveyed field were subjected to isolation using tissue isolation technique. Total twenty isolates were obtained from the twenty different villages surveyed. These isolates were further identified as *Fusarium* spp. on the basis of their morphological and cultural characteristics. The various morphological characters studied for identification of *Fusarium* spp. were the growth behavior, colour shape, diameter, *etc.* The most important characters *viz.*, microconidia, macroconidia and chlamydospores their conidial septation were also studied. The isolation and purification of process of *Fusarium* spp. is shown in Fig. 2. From the twenty isolates obtained, eight isolates *viz.*, BVV-1, BVD-1, BJG-3, BJNs-1, BNM-1, BNA-1, BNB-1 and BJS-2 were found positive and maintained by subsequent culturing. These isolates were then grown on PDA media and were further sub-cultured for purification and maintained on PDA slant at 4°C. Then the further investigation was carried out using this pure culture. These results were in conformity with the findings of Tosi *et al.* (2000) where they collected the infected plant showing withering and wilted symptoms. On isolation they found *Fusarium* spp. causing chilli wilt disease from roots and stem collar zone of diseased pepper plants.

Conclusion

The results of the present research work concluded that Fusarial wilt disease of chilli caused by *Fusarium* spp. is becoming major problem that for chilli growing farmers of Bharuch district. The maximum PDI of 70 per cent was recorded for the Valia taluka followed by 66.13 per cent for Jagadiya and 59.16 per cent for the Netrang taluka of Bharuch district. While the minimum PDI 38.66 per cent was recorded for the Bharuch taluka. The highest PDI 88 per cent and the lowest PDI 24 per cent was recorded for the Vadfaliya village of Valia taluka and Nikora village of Bharuch taluka, respectively.



A. Collection of samples

B. Isolation

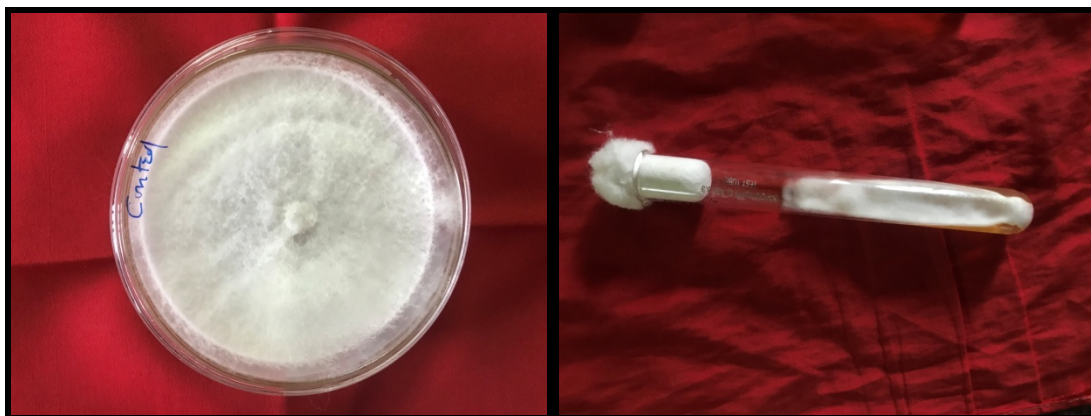


Fig. 2 Collection of samples, isolation and purification of pathogen

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