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Survey on the incidence of *Fusarium* wilt of chilli in the agro-ecological condition of red and lateritic zone of West Bengal

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Abstract

Chilli (*Capsicum annuum* L.) is one of the important vegetable as well as spice crops belonging to the nightshade family Solanaceae, which are amply cultivated in all parts of the world's subtropical and tropical regions. *Fusarium* wilt is the major limiting factor in chilli production, caused by *Fusarium oxysporum* has emerged as a serious problem in past decade. A survey was conducted to investigate the occurrence and distribution of *Fusarium* wilt in the agro-ecological condition of red and lateritic zones of West Bengal during the rabi season of 2021–22. In this investigation, fields of important chilli growing areas across Birbhum and Bankura districts were selected to conduct the survey. The percent disease incidence (PDI) was calculated through periodic observations at 35, 50, and 65 days after transplanting (DAT). The maximum percent disease incidence of 32.45% was found in Bankura district of Araldihi followed by Birbhum district of Hetampur (30.41%) and minimum incidence was observed in Birbhum district of Sian (19.48%). A mean disease incidence ranging from 32.26 to 34.51% followed by Birbhum district 26.18 to 32.11% was observed. The result of the survey revealed that wide range of infection and incidence of *Fusarium* wilt disease occurred in Bullet lanka-9 variety compared to all other varieties. This study emphasizes the critical role of environmental factors in disease proliferation and highlights the need for resistant varieties and improved management practices to mitigate losses. These findings provide valuable insights for designing targeted disease control strategies in chilli cultivation.

Keywords: Survey, chilli, *Fusarium* wilt, disease incidence

Introduction

Vegetables are an essential for human nutrition as they provide many nutrients in the form of fiber, vitamins and minerals. Chilli (*Capsicum annuum* L.) is one of the important vegetable as well as spice crops belonging to the nightshade family Solanaceae, which are amply cultivated in all parts of the world's subtropical and tropical regions. The crop was introduced to India in 1498 and originated from South and Central America (Madhavi Reddy *et al.*, 2023) ^[1]. The primary centre of origin of chilli is reported to be Mexico with secondary centres in Guatemala and Bulgaria (Salvador, 2002) ^[2]. China, India, Ethiopia, Pakistan, Indonesia, Korea and Bangladesh are major chilli growing countries. India is popularly known as “spice bowl of the world” and is the world's largest producer, consumer and exporter of chillies. The area under chilli cultivation in India is around 7.33 lakh hectare with production of 17.64 lakh tonnes (Anonymous, 2016) ^[3]. The chilli area cultivation, production and productivity are 62.39 Ha, 217.65 MT and 3.49 MT/Ha respectively, in West Bengal (Anonymous, 2021) ^[4]. Chilli fruit has commercially two important qualities, capsaicin is responsible for the pungency in chilli and red colour is due to the presence of pigment called Capsanthin (Nehra, 2016) ^[5]. Chilli is known to be one of the major sources of carotenoids, precursors of vitamin A and ascorbic acid (vitamin C). It is stressed by various fungal, bacterial pathogens and abiotic factors. One among of the fungal diseases is *Fusarium* wilt, caused by *Fusarium oxysporum* has emerged as a serious problem in past decade (Anonymous, 2005) ^[6]. The disease can infect at various stages of plant growth with more incidences at flowering and fruiting stage and results in partial to complete failure of crop (Wani *et al.*, 2014) ^[7].

The symptoms of *Fusarium* wilt are characterized by wilting and yellowing of leaves, stunted growth, accompanied by the upward and inward rolling of leaves and eventually death of the whole plant within a few days (Reddy *et al.*, 2024) [8]. *Fusarium oxysporum* can produce different types of spores: micro-conidia, macro-conidia and chlamydospores. The pathogen is extremely adaptable, variable and capable of long persistence in soil as chlamydospores (Nelson *et al.*, 1981) [9]. The maximum growth of the genus *Fusarium* is commonly obtained at 28 °C, inhibited above 33 °C and not favoured below 17 °C, while the optimum growth is found between 25 to 28 °C (Cook and Baker, 1983) [10]. Generally, the dry weather conditions, high temperature and excessive soil moisture significantly contribute to the development of infection and disease (Sanogo, 2003) [11]. *Fusarium* wilt of chilli is the most prevalent soil-borne disease and causes yield loss ranging from 10-50% globally and 10-80% in India. Moreover, this disease can be observed throughout the year, but in India, the incidence is notably higher during the months of November-December compared to the rest of the year (Bai *et al.*, 2018) [12]. Therefore the present study was carried out to find the occurrence and distribution pattern of *Fusarium* wilt disease of chilli in the Agro-ecological condition of red and lateritic zone of West Bengal.

Materials and Methods

Survey for assess the disease incidence

The present study was conducted at different locations from two districts under the red and lateritic zone of West Bengal during Rabi season, 2021-22. Fields of important chilli growing areas of Birbhum and Bankura districts were selected to conduct the survey. For this study, different farmer's field were undertaken viz. Binuria, Raipur, Sian, Ruppur, Surul, Kienahar, Ghurisa, Hetampur from Birbhum district and Araldihi, Barbakra from Bankura district (Table 1). Four randomly chosen fields of nearly the same size were selected in each location. The disease incidence was assessed by counting the number of infected plants exhibiting *Fusarium* wilt disease symptoms such as yellowing of young leaves, stunting of older leaves and wilting of plants/m² of a randomly selected area in chilli field. The observations were taken periodically at 35, 50 and 65 days after transplanting. The percent disease incidence (PDI) was calculated by using the formula (Patra *et al.*, 2017) [13].

$$\text{Percent Disease Incidence} = \frac{\text{No. of Plants showing wilting symptoms}}{\text{Total no. of plants observed}} \times 100$$

Results and Discussion

To determine the occurrence and distribution pattern of

Fusarium wilt disease of chilli, surveys were conducted during the rabi season 2021-22 in different locations of red and lateritic zone of West Bengal. The severity of the disease recorded in Birbhum and Bankura districts from different farmer's field. The observed data have been presented in Table 2.

On investigation, it was evident that the severity of *Fusarium* wilt disease of chilli varied from locality to locality and variety grown. The overall percent disease incidence (PDI) was recorded in all surveyed areas with varied levels which ranged from 6.35% to 32.45%. The maximum percent disease incidence of 32.45% was found in Bankura district of Araldihi followed by Birbhum district of Hetampur 30.41% and minimum incidence was observed in Birbhum district of Sian 19.48% (Table 2; Fig. 1).

Among the locations surveyed, percent disease incidence (PDI) was maximum in the predominant variety Bullet lanka-9 at the village Araldihi of Indpur block under Bankura district and it was minimum in the variety Bullet lanka-8 at the village Sian of Bolpue-Sriniketan block under Birbhum district. While comparison of the incidence level of wilt disease in the two districts the mean (pooled) value indicated the Bankura district had maximum level of disease incidence ranging from 32.26 to 34.51% followed by Birbhum district 26.18 to 32.11% (Table 2). Birbhum district was noticed with less incidence levels ranging from 11.88 to 19.89% than Bankura district which is 18.74 to 21.02% during the rabi season under surveyed. Bullet lanka-9 variety was found to be more infected with *Fusarium* wilt disease than other varieties. This may be due to lack of genetic resistance and unavailability of rhizospheric microbial population had in comparison to other variety. Bullet lanka-8 variety is moderately resistant to *Fusarium* wilt of disease which could be the main reason for low disease incidence. The higher incidence of *Fusarium* wilt of chilli in Bankura district in comparison to Birbhum district was probably due to favourable conditions like atmospheric temperature, soil moisture and temperature which help the pathogen *Fusarium oxysporum* for rapid multiplication and growth in soil. Initially, the disease increased more slowly, but between 50 and 65 DAT of crop, it increased more quickly. This was mostly due to the increased temperature and the warmer soil during mid-February to mid-March which made atmosphere more opportune for the development of *Fusarium oxysporum* in soil of the lateritic belt of West Bengal. Considering the block averages Indpur block of Bankura district observed the highest disease incidence with a mean severity 34.51% and Bolpur-Sriniketan block of Birbhum district observed the least disease incidence with a mean disease severity 26.18%.

Table 1: Different selected locations and varieties of Birbhum and Bankura district for the survey

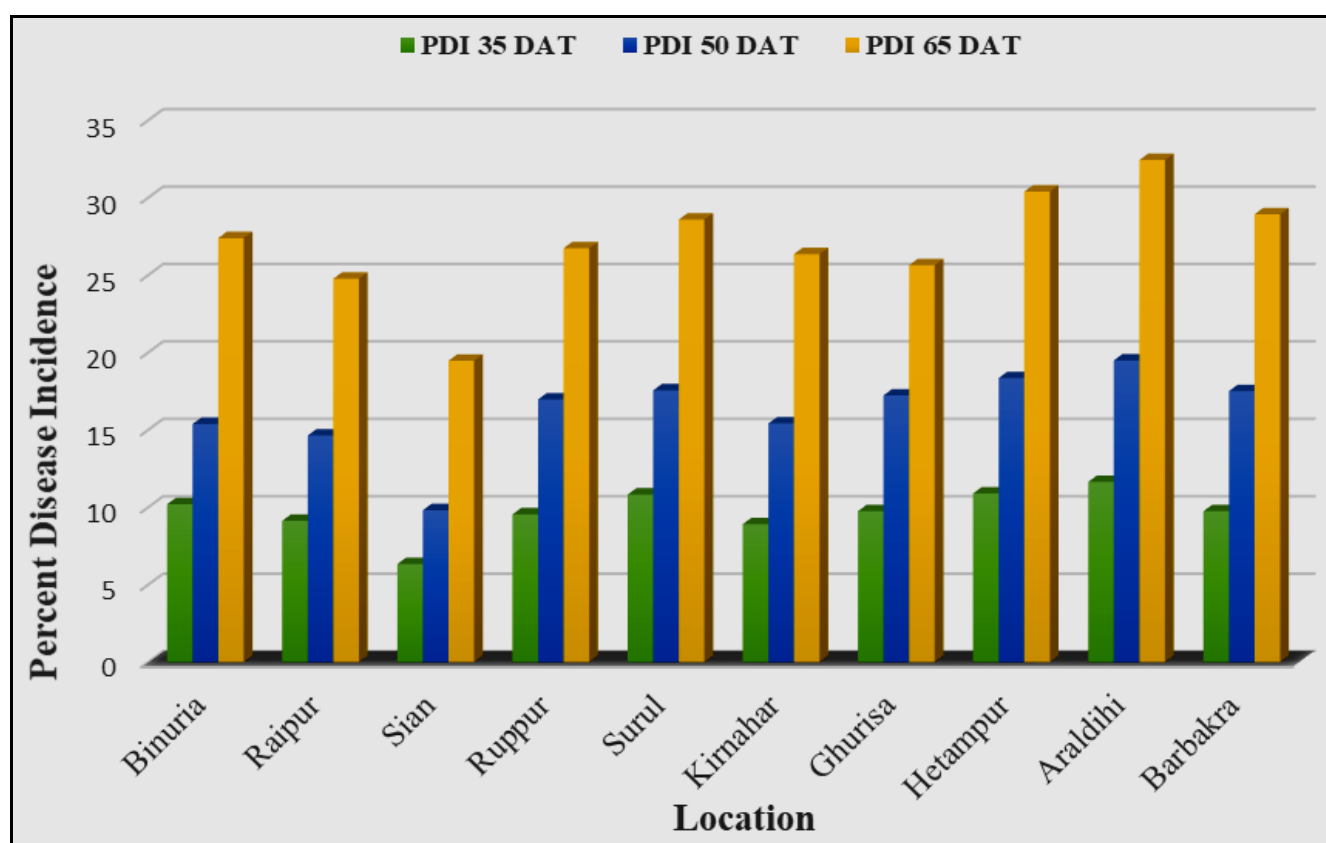
S. No	District	Block	Village	Variety	Coordinates	
					Latitude	Longitude
1	Birbhum	Bolpur-Sriniketan	Binuria	Bullet lanka-1	23°40'33" N	87°39'37" E
			Raipur	Bullet lanka-6	22.79°38'13" N	86.94°38'49" E
			Sian	Bullet lanka-8	23.66°40'30.50" N	87.75°43'20.45" E
			Ruppur	Arka Harita	23.66°41'31.05" N	87.60°42'19.55" E
			Surul	Bullet Lanka-6	23°40'13.04" N	87.65°39'25.03" E
		Nanoor	Kirnahar	Bullet Lanka-1	23.70°43'36" N	87.86°52'37" E
		Illambazar	Ghurisa	Bullet lanka-8	23.63°38'36" N	87.53°32'37" E
2	Bankura	Dubrajpur	Hetampur	IR8	23.37°49'36" N	87.37°23'37" E
		Indpur	Araldihi	Bullet lanka-9	23°10'0.12" N	86°55'59.9" E
		Chhatna	Barbakra	S-11	23°18'0.63" N	86°58'57.8" E

Table 2: Disease incidences of *Fusarium* wilt of chilli under red and lateritic zone of West Bengal during 2021-22

S. No	District	Block	Village	Variety	Percent Disease Incidence			Average PDI
					35 DAT	50 DAT	65 DAT	
1	Birbhum	Bolpur-Sriniketan	Binuria	Bullet lanka-1	10.21 (19.35)*	15.40 (23.30)*	27.40 (31.56)*	17.67
			Raipur	Bullet lanka-6	9.14 (18.22)*	14.65 (22.25)*	24.78 (29.64)*	16.19
			Sian	Bullet lanka-8	6.35 (15.10)*	9.83 (18.38)*	19.48 (26.18)*	11.88
			Ruppur	Arka Harita	9.56 (18.01)*	16.98 (24.23)*	26.75 (31.31)*	17.76
			Surul	Bullet Lanka-6	10.84 (19.34)*	17.57 (24.79)*	28.60 (32.11)*	19.00
		Nanoor	Kirnahar	Bullet Lanka-1	8.92 (16.17)*	15.43 (23.42)*	26.37 (31.07)*	16.90
		Illambazar	Ghurisa	Bullet lanka-8	9.76 (18.35)*	17.24 (24.69)*	25.65 (30.52)*	17.55
		Dubrajpur	Hetampur	IR8	10.91 (19.33)*	18.36 (25.48)*	30.41 (33.78)*	19.89
2	Bankura	Indpur	Araldihi	Bullet lanka-9	11.65 (20.07)*	19.50 (26.24)*	32.45 (34.51)*	21.02
		Chhatna	Barbakra	S-11	9.76 (18.34)*	17.52 (24.48)*	28.94 (32.26)*	18.74
S.E(m) ±					0.473	0.519	0.351	
CD(P=0.05)					1.418	1.553	1.050	
*Figures in parentheses indicate angular transformed values. PDI= Percent Disease Incidence								

The results of the present study were corroborated with Birla (2014) ^[14] who observed the maximum average disease incidence 34.93% from Khargone in Madhya Pradesh. Bai *et al.* (2018) ^[12] examined the incidence of *Fusarium* wilt in Andhra Pradesh ranging from 8 to 40% in Kurnool district and 6 to 24% in Kadapa district. Similarly, Mishra *et al.* (2018) ^[15] have also reported a high level of disease incidence from Etawah (50-70%) district in Uttar Pradesh. In India, wilt diseases of chilli

have been reported from various parts of the country such as Karnataka (Rao *et al.*, 2012) ^[16], Andhra Pradesh (Raghu and Benagi, 2014) ^[17] and Kashmir valley (Rather *et al.*, 2012) ^[18]; Dar *et al.*, 2018 ^[19]; Muzaffar *et al.*, 2021) ^[20]. In addition, Joshi *et al.* (2012) ^[21] stated wilt disease is influenced by environmental factors like soil temperature, soil moisture and soil type all have an impact on the growth and development of soil microbial populations.

**Fig 1:** Disease incidences of *Fusarium* wilt of chilli under red and lateritic zone West Bengal during 2021-22

Conclusion

The present study provides a significant impact of *Fusarium* wilt caused by *Fusarium oxysporum* on chilli production in the red and lateritic zones of West Bengal, specifically during the 2021-22 rabi season. The survey revealed that *Fusarium* wilt is becoming a major problem for chilli cultivation, with varying degrees of severity observed across different locations. The major chilli-growing areas of Birbhum and Bankura districts showed varying levels of disease incidence, with the highest prevalence in Araldihi (32.45%) of Indpur block under Bankura district and the lowest in Sian (19.48%) of Bolpur-Sriniketan block under Birbhum district. The susceptibility of the varieties grown, soil types and environmental factors such as temperature, and soil moisture are contributed to differences in disease incidence. The results underscore the importance of developing resistant chilli varieties and implementing integrated disease management practices to reduce crop losses. These findings offer critical insights for tailored control strategies and highlight the need for proactive measures to enhance chilli production sustainability in the region.

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