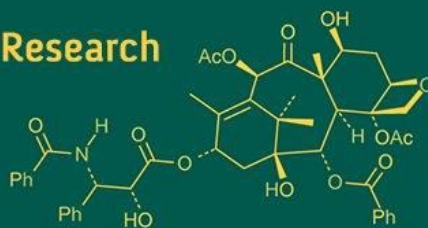


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Status of chilli powdery mildew in major cultivation zones of Telangana

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Abstract

Powdery mildew, caused by *Leveillula taurica* (Lév.) Arn., is one of the most serious foliar diseases of chilli (*Capsicum annuum* L.), leading to significant yield losses under favorable conditions. A roving survey was conducted across five chilli growing districts of Telangana during Rabi 2024-25 to assess the severity of the disease. Observations were recorded from 45 villages covering different varieties, soil types, and crop stages. Results revealed significant variability across districts. Gadwal recorded the highest mean PDI (66.85%), followed by Khammam (42.56%), Warangal (34.95%), Nalgonda (38.41%), and Suryapet (33.45%). Village level analysis showed that maximum severity (72.0%) occurred in Waddepally, Gadwal district, whereas the lowest severity (19.28%) was recorded in Yopalasingaram, Suryapet district. The overall mean PDI across districts was 44.48%. High coefficients of variation in Nalgonda (36.92%) and Suryapet (27.43%) suggest localized disease outbreaks, influenced by varietal susceptibility and soil-climate interactions.

Keywords: Chilli, *Leveillula taurica*, powdery mildew, disease severity, Telangana

Introduction

Chilli (*Capsicum annuum* L.) is one of the most economically important spice crops grown globally, valued not only for its culinary uses but also for its pharmaceutical and industrial applications. India is the largest producer, consumer, and exporter of chilli, accounting for nearly 36% of global production (FAO, 2022) [2]. Telangana, Andhra Pradesh, Karnataka, and Madhya Pradesh are the leading chilli-growing states in India, with Telangana contributing significantly to both domestic markets and exports (Kumar *et al.*, 2020) [7]. The crop's commercial success is, however, hampered by several abiotic stresses and devastating diseases.

Among foliar diseases, powdery mildew caused by *Leveillula taurica* (Lév.) Arn. is of major concern. This obligate biotrophic pathogen, belonging to the family Erysiphaceae, has a broad host range infecting solanaceous crops such as chilli, tomato, and brinjal (Pérez-García *et al.*, 2009) [12]. Unlike most powdery mildew fungi that produce superficial hyphae, *L. taurica* exhibits an unusual infection biology, its hyphae colonize the mesophyll tissue, while sporulation occurs externally through stomata. This endophytic growth pattern not only complicates its diagnosis but also reduces the effectiveness of surface-applied fungicides (Bertrand, 2019) [1]. The disease typically appears as whitish powdery patches on the lower leaf surface, often accompanied by chlorotic or necrotic spots on the upper surface. Severe infections cause premature leaf drop, reduced photosynthesis, and poor fruit development, ultimately leading to yield losses of 30-50% depending on variety, climate, and management practices (Kamble *et al.*, 2019; Singh *et al.*, 2021) [6, 16].

Environmental factors such as high temperatures, dry weather, and intermittent humidity strongly favor the pathogen's development (Patel *et al.*, 2022) [10]. These conditions are prevalent in Telangana during the Rabi season, making chilli particularly vulnerable. The predominance of susceptible varieties such as 'Teja' further exacerbates the situation.

While sporadic reports on the occurrence of powdery mildew in chilli exist from Gujarat, Karnataka, and Andhra Pradesh (Reddy *et al.*, 2018; Patel *et al.*, 2022) [13, 10], systematic surveys across Telangana are scarce. Baseline data on disease distribution, severity, and varietal susceptibility are essential for designing integrated disease management (IDM) strategies, guiding resistant variety deployment, and forecasting disease outbreaks.

Therefore, the present investigation was conducted to study the severity and distribution of powdery mildew in major chilli-growing districts of Telangana during *Rabi* 2024-25.

Materials and Methods

An intensive roving survey was carried out during *Rabi* 2024-25 in the major chilli-growing districts of Telangana, namely Gadwal, Warangal, Nalgonda, Suryapet, and Khammam. These districts were selected based on their large cultivation area, predominance of commercial varieties, and farmers' reports of powdery mildew occurrence. The survey was conducted between November and December 2024, coinciding with the flowering to fruiting stage of the crop, a period known to be highly conducive for powdery mildew development (Kamble *et al.*, 2019; Singh *et al.*, 2021) [6, 16].

In each district, three mandals were selected, and in each mandal, three representative villages were surveyed. Within

each village, three farmers' fields were assessed. From each field, four quadrants of 1 m² area (approximately 10 randomly selected plants) were observed to record disease severity. This hierarchical sampling ensured adequate representation of the variability in disease occurrence across agro-ecological conditions (Reddy *et al.*, 2018; Patel *et al.*, 2022) [13, 10].

Disease Assessment

Powdery mildew severity was scored visually on a 0–9 scale (Table 1) developed by Mayee and Datar (1986) [9]. The Per cent Disease Index (PDI) was calculated using the formula proposed by Wheeler (1969) [18]:

PDI=

(Sum of numerical ratings)/{Total number of observations × Maximum rating scale}×100

Table 1: Disease severity scoring scale for powdery mildew of chilli (Mayee and Datar, 1986) [9]

Grade	Description
0	No symptom of powdery mildew.
1	Small scattered powdery mildew specks covering 1% or less leaf area.
3	Small powdery lesions covering 1-10% of leaf area
5	Powdery lesions enlarged covering 11-25% of leaf area.
7	Powdery lesions coalesce to form big patches covering 26-50% of leaf area.
9	Big powdery patches covering 51% or more of leaf area and defoliation occurs.

GPS and Agro ecological data collection

The geographical coordinates (latitude and longitude) of each surveyed field were recorded using a handheld Global Positioning System (GPS) device to map disease distribution. Additional information such as variety grown, soil type and crop stage was collected through farmer interviews and field observations. Recording these parameters facilitated correlation analysis between environmental and varietal factors with disease severity (Pérez-García *et al.*, 2009) [12].

Statistical analysis

District-wise mean PDI, range, standard error (SE), and coefficient of variation (CV) were computed to assess variability in disease distribution. The mean PDI values were arcsine transformed prior to statistical analysis to stabilize variance (Gomez and Gomez, 1984) [5]. Microsoft Excel and SPSS statistical packages were used for data analysis.

Results

District wise severity of powdery mildew

Powdery mildew incidence was observed in all surveyed districts of Telangana during *Rabi* 2024-25, with considerable variation in disease severity. The highest mean PDI was recorded in Gadwal (66.85%), followed by Khammam (42.56%), Nalgonda (38.41%), Warangal (34.95%), and the lowest in Suryapet (33.45%). This indicates that Gadwal district served as a hotspot for powdery mildew during the survey period. The pooled analysis across districts showed an overall mean PDI of 44.48%, reflecting a moderate to high disease pressure in the state. (Table 2 and Fig. 1 and 2).

Village level variation

At the village level, disease severity ranged widely, with a maximum of 72.00% PDI recorded in Waddepally mandal of Gadwal district, where the susceptible variety 'Teja' was grown under red soil conditions. In contrast, the lowest severity (19.28% PDI) was noted in Yopalasingaram village of Suryapet district. Other high severity locations included Chandur (70.89% PDI, Gadwal), Gollanapadu (56.12% PDI, Khammam), and Kommepalle (56.15% PDI, Nalgonda) (Table 2). This variation highlights the influence of local agro-climatic factors and varietal susceptibility. Villages cultivating the widely grown commercial cultivar 'Teja' consistently showed higher disease severity compared to fields planted with 'Byadgi Kaddi' or 'US 1081', which exhibited comparatively lower infection levels.

Analysis of district wise statistical parameters (Table 3) revealed notable variability: Arcsine mean values ranged from 35.0° (Suryapet) to 54.9° (Gadwal), reflecting differences in overall disease severity. Coefficient of variation (CV) was highest in Nalgonda (36.92%), indicating heterogeneous distribution of the disease, while the lowest CV was recorded in Gadwal (6.39%), suggesting uniform and widespread infection in that district. Standard error (SE) values were lowest in Gadwal (1.43), supporting the uniformity of disease pressure, whereas higher SE values in Warangal (2.80), Nalgonda (4.73), and Khammam (3.39) indicated variability within sampled fields. The range of PDI across districts was wide, with the narrowest in Gadwal (14.78%) and the broadest in Nalgonda (36.02%), again confirming localized differences.

Table 2: Severity of chilli powdery mildew in Telangana during *Rabi* 2024-25

District	Mandal	Village	Variety	Soil type	Crop stage	Longitude	Latitude	PDI
Gadwal	Manopad	Pallepadu	Teja	Red soils	Fruiting	77.989367	16.056957	67.78
		Chandur	Teja	Red soils	Fruiting	78.004761	16.056698	70.89
		Jallapur	Teja	Black soils	Fruiting	77.985522	16.025221	65.67
	Waddepally	Shanti nagar	Teja	Red soils	Fruiting	851.291	15.952609	72.00
		Paipadu	Teja	Red soil	Fruiting	77.877034	15.956917	65.56
		Rampuram	Teja	Red soil	Fruiting	77.821473	16.003434	68.11
	Aiza	Venkatapur	U S 1081	Red soils	Fruiting	77.748823	15.988025	57.22
		Aiza	U S 1081	Red soils	Fruiting	77.650866	16.015409	68.78
		Thimmapur	Teja	Black soils	Fruiting	78.000735	17.265075	65.67
Mean PDI								66.85%
Warangal	Hanmakond a	modikonda	Teja	Red soils	Fruiting	79.482841	17.965323	44.66
		Paipalle	Teja	Red soils	Fruiting	79.712673	18.210001	36.88
		Thimmapur	Teja	Red soils	Fruiting	79.571163	17.922065	50.89
	Kesanudra m	Annaram	Byadgi kaddi	Black soils Red soils	Fruiting	79.618499	18.004045	40.44
		Korukonda palle	Byadgi kaddi	Black soils Red soils	Fruiting	79.837502	17.708397	32.89
		Rangapura m	Teja	Black soils Red soils	Fruiting	79.846197	18.084903	48.67
	Bhupalpalle	Azamnagar	Teja	Red soils	Fruiting	80.061704	18.514601	35.82
		Kamalapur	Teja	Red soils	Fruiting	79.905324	18.472414	42.11
		Jangedu	Teja	Red soils	Fruiting	79.831442	18.436496	26.93
Mean PDI								34.95%
Nalgonda	Devarakond a	Atchampet	Teja	Red soils Black soils	Fruiting	79.002452	16.646591	24.33
		Gummadav alley	Byadgi kaddi	Red soils	Fruiting	79.0015858	16.7500211	46.67
		Kommepall e	Teja	Red soils	Fruiting	78.8221461	16.6675710	56.15
	Damaracher la	Chityala	Teja	Red soils	Fruiting	79.4498123	16.6434774	32.18
		Dilawarpur	Teja	Black soils Red soils	Fruiting	79.5761828	16.8002967	20.13
		Kesawapur	Teja	Red soils	Fruiting	79.6471492	16.7850193	22.14
	Madulapall ey	Agamothku r	Teja	Black soils Red soils	Fruiting	79.5005397	17.0426191	41.32
		Gandravani guda	Teja	Red soils	Fruiting	79.4934974	16.9583741	56.12
		Thopucherl a	Teja	Black soils Red soils	Fruiting	79.5131992	16.9761907	46.67
Mean PDI								38.41%
Suryapet	Chilkur	Kondapura m	Teja	Red soils	Fruiting	79.8695271	16.9847106	32.18
		Paleannara m	Gunturusan nalu	Red soils	Fruiting	79.9286420	16.9335239	29.28
		Bethavole	Teja	Red soils	Fruiting	79.8435123	16.9807648	45.16
	Huzurnagar	Buruyadda	Teja	Black soils Red soils	Fruiting	79.8535592	16.9349013	23.24
		Machavara m	Teja	Red soils	Fruiting	78.237007	18.0129679	36.18
		Yepalasinga ram	Teja	Red soils	Fruiting	79.9082220	16.8686229	19.28
	Kodad	Ganapavara m	Teja	Black soils Red soils	Fruiting	79.9583597	16.8994190	42.18
		Chimiryala	Teja	Black soils Red soils	Fruiting	80.0348630	16.9859736	40.12
		Komaraban da	swarajmukh i	Red soils	Fruiting	79.9285413	17.0435365	32.14
Mean PDI								33.45%
Khammam	Konijerla	Tanikella	Teja	Red soils	Fruiting	80.2551516	17.2411660	25.42
		Pallipadu	Teja	Red soils	Fruiting	80.3229331	17.2098266	36.18
		Thummalap alli	Teja	Black soils	Fruiting	80.2910278	17.2583154	42.43
	Wyra	Gannavara m	Teja	Black soils Red soils	Fruiting	80.3707464	17.0809574	39.52
		Gollanapad u	Teja	Black soils Red soils	Fruiting	80.1205732	17.3052346	56.12
		Paladugu	Teja	Red soils	Fruiting	80.3290330	17.0780533	49.42
	Tallada	Gopalapeta	Gunturusan nalu	Black soils Red soils	Fruiting	80.4513476	17.2725206	32.10
		Kalakodima	Teja	Red soils	Fruiting	80.4588681	17.1218582	49.18
		Laxmipura m	Teja	Red soils	Fruiting	80.0720658	17.2094042	52.65
Mean PDI								42.56%
Overall mean PDI								44.48

Table 3: District-wise severity of chilli powdery mildew in Telangana during *Rabi* 2024-25

District	Mean PDI (%)	Arcsine Mean (°)	Range (%)	Standard Error (SE)	Coefficient of Variation (CV%)
Gadwal	66.85	54.9	14.78	1.43	6.39
Warangal	42.07	40.3	17.99	2.80	16.58
Nalgonda	38.41	38.4	36.02	4.73	36.92
Suryapet	33.45	35.0	25.88	3.24	27.43
Khammam	42.56	40.7	30.70	3.39	23.93
Overall	44.48	41.8	52.72	2.26	33.72



Fig 1: Symptoms of chilli powdery mildew observed during survey

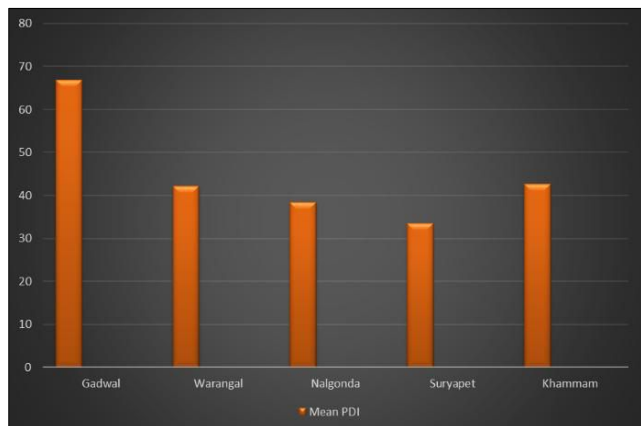


Fig 2: Graph shows the district-wise mean powdery mildew severity (PDI) of major chilli growing districts of Telangana

Discussion

The present roving survey clearly demonstrated that chilli powdery mildew caused by *L. taurica* is widespread in Telangana, with disease severity varying significantly across districts, mandals, and villages. The overall mean PDI of 44.48% indicates moderate to high disease pressure during *Rabi* 2024-25. Among districts, Gadwal recorded the highest mean severity (66.85%), while Suryapet exhibited the lowest (33.45%). Such variability is consistent with earlier studies that reported regional differences in powdery mildew severity depending on varietal susceptibility, soil type, and microclimatic conditions (Reddy *et al.*, 2018; Patel *et al.*, 2022) [13, 10]. The present findings are in line with earlier reports where powdery mildew caused yield losses of 14-30% in chilli (Gohokar and Peshney, 1981; Saroj and Satish, 1985) [4, 14]. The wide variability observed in Telangana supports the view that powdery mildew epidemics are location- and season-specific, depending on varietal susceptibility and weather conditions (Geetha *et al.*, 2017) [3]. Similar survey-based assessments in Andhra Pradesh and Karnataka have also indicated Gadwal-type regions as hot-spots for the pathogen (Udit Joshi *et al.*, 2021) [17]. Recent studies have highlighted that high humidity (>70%) and temperatures between 20-28°C are strongly correlated with rapid development of *Leveillula taurica*, leading to epidemic outbreaks (Patil and Gopal, 2022) [11]. Early sowing combined with wider spacing has been reported to reduce disease incidence significantly by lowering canopy humidity (Kumar *et al.*, 2023) [8]. Moreover, resistant cultivars such as US-1081 and Byadgi kaddi have consistently shown lower disease severity under epiphytotic conditions, confirming their potential for integrated management (Sharma and Singh, 2023) [15]. Fields dominated by the commercial cultivar 'Teja' consistently showed higher disease severity across districts, especially in Gadwal and Khammam. This supports earlier reports that 'Teja' is highly susceptible to *L. taurica*

(Kamble *et al.*, 2019) [6]. In contrast, varieties such as 'Byadgi Kaddi' and 'US 1081' exhibited relatively lower PDI, suggesting partial tolerance. Such findings underscore the critical role of varietal resistance in disease epidemiology (Singh *et al.*, 2021) [16]. Furthermore, higher severity in red soils compared to black soils in some villages suggests that soil type and associated microclimatic conditions may influence disease expression, although this requires further experimental validation.

Powdery mildew development is favored by warm, dry climates with intermittent humidity (Pérez-García *et al.*, 2009) [12]. The *Rabi* season in Telangana provides exactly such conditions, which likely contributed to the high severity observed in Gadwal and Khammam. The low coefficient of variation (6.39%) in Gadwal indicates uniform and widespread infection, reflecting conducive environmental conditions coupled with cultivation of a single susceptible variety. By contrast, higher CV values in Nalgonda (36.92%) and Suryapet (27.43%) highlight localized outbreaks, possibly linked to variation in cropping systems, varietal diversity, and microclimate.

The overall PDI (44.48%) observed in Telangana aligns with reports from Andhra Pradesh (Reddy *et al.*, 2018) [13], where mean severity ranged between 35-55%. Similarly, Patel *et al.* (2022) [10] reported severity levels of 30-60% in chilli growing tracts of Gujarat. These parallels confirm the adaptability of *L. taurica* across diverse agro-ecological zones of India. Pérez-García *et al.* (2009) [12] also highlighted the pathogen's ability to persist under a wide range of environmental conditions due to its unique endophytic growth.

Conclusion

The survey has clearly identified Gadwal and Khammam districts as critical zones with uniformly high disease pressure, while Nalgonda and Suryapet exhibited heterogeneous severity. The observed CV and SE values confirm the adequacy of the survey design, and the results provide a baseline for targeted disease management, varietal screening, and forecasting models in Telangana.

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