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Study on powdery mildew of cucumber caused by *Erysiphe cichoracearum*

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Abstract
Powdery mildew, caused by Erysiphe cichoracearum, severely damages tropical and temperate cucumber crops, inducing chlorosis, defoliation, and reduced photosynthesis. To map regional distribution and infection hotspots in southern Rajasthan, a systematic roving survey was conducted across Udaipur, Chittaurgarh, and Banswara districts during the 2024–25 cropping season. Micro-regional sampling spanned nine agricultural blocks: Bargaon, Bhinder, and Girwa (Udaipur); Barisadri, Begun, and Bhadesar (Chittaurgarh); and Anandpuri, Arthuna, and Garhi (Banswara). Fungal expression was evaluated at multiple growth stages using Percent Disease Incidence and Percent Disease Index (PDI) via a 1–9 visual leaf-coverage scale. The regional mean disease incidence reached 48.65% with a severity of 40.85 PDI. Banswara emerged as the primary hotspot (55.90% incidence, 47.85 PDI), with peak damage in Anandpuri and Garhi due to high humidity. Chittaurgarh showed moderate infection (48.25% incidence, 40.10 PDI), spiking in Barisadri during reproductive stages. Udaipur recorded the lowest baseline values (41.80% incidence, 34.60 PDI), particularly in early-planted Bargaon fields. Because incidence exceeded severity, local microclimates and farming practices clearly altered infection levels. These baseline data are vital for building localized forecasting tools, timing chemical sprays, and launching resistance breeding programs.

Keywords: Cucumber, Powdery Mildew, *Erysiphe cichoracearum*, Roving Survey, Disease Incidence, Percent Disease Index (PDI), Block-Level Dynamics, Hotspot Mapping, Southern Rajasthan

Introduction
Powdery mildew—incited primarily by *Golovinomyces cichoracearum* (syn. *Erysiphe cichoracearum*)—stands out as an exceptionally destructive disease under both open-field conditions and protected farming structures. The fungus operates as an obligate parasite, initially establishing minute, white powdery patches on young foliage that rapidly expand to coat extensive surface areas of leaves and structural stems . This heavy mycelial covering triggers chlorophyll chlorosis, premature defoliation, and decreased photosynthetic capability. Consequently, yield losses ranging between 50% and 70% are frequently recorded when field environments favor early pathogenesis. Because powdery mildew development is highly sensitive to microclimatic elements like relative humidity and temperature variations, its structural severity remains deeply region-specific. Establishing effective management practices requires systematic field surveys to identify hotspot zones and map out regional disease intensity. While literature details its severity in regions like northern Karnataka or Uttar Pradesh, systematic survey data regarding southern Rajasthan's cucumber tracts remains scarce. Addressing this gap, this study systematically tracks, evaluates, and establishes the localized distribution, incidence, and severity of *E. cichoracearum* across major cucumber-producing pockets of southern Rajasthan.

Materials and Methods
Survey Design and Sampling Sites
An extensive roving field survey was completed during the 2024–25 crop seasons across the agricultural zones of southern Rajasthan. Three prominent cucumber-cultivating districts were chosen for evaluation: Udaipur, Chittaurgarh, and Banswara. To guarantee thorough regional representation and micro-climatic resolution, three distinct production blocks were systematically monitored in each target district: Udaipur District: Bargaon, Bhinder, and Girwa. Chittaurgarh District: Barisadri, Begun, and Bhadesar. Banswara District: Anandpuri,

Arthuna, and Garhi. Observations were recorded at varying vegetative and reproductive crop growth stages across multiple farmer fields.

Assessment of Disease Incidence and Severity

Field disease incidence was mathematically calculated by counting the number of symptomatic, infected plants relative to the total plant population observed within designated sample plots. The assessment used the standard equation outlined by Wheeler (1969):

$$\text{Disease Incidence (\%)} = \frac{No.of\ infected\ units}{\text{Total no.of units observed}} \times 100$$

Disease severity profiles were calculated from randomly selected sample leaves using a modified 1–9 morphological rating scale as suggested by Naik and Kulkarni (2018) and Mayee and Datar (1986). The scale categorizes leaf area damage using the following visible diagnostic benchmarks

Table 1: Disease Severity Rating Scale for Assessing Powdery Mildew Infection in Cucumber Leaves

Score	Per cent disease severity
0	No visible symptoms of powdery mildew on leaves
1	Small, scattered powdery mildew specks covering 1 per cent or less of leaf area
3	Small powdery lesions covering 1–10 per cent of leaf area
5	Enlarged powdery lesions covering 11–25 per cent of leaf area
7	Coalesced powdery lesions forming large patches covering 26–50 per cent of leaf area
9	Extensive powdery patches covering 51 per cent or more of leaf area with defoliation

$$\text{Percent Disease Index} = \frac{\text{Sum of all numerical ratings}}{\text{Total number of leaves observed} \times \text{Maximum disease grade}} \times 100$$

Data Analysis

The mean PDI values for individual tehsils and overall districts were aggregated and descriptive statistical comparisons were compiled using MS-Excel and basic analytical packages to interpret spatial variation against regional agro-climatic conditions.

Results

Field Diagnostics and Distribution

The field survey confirmed that powdery mildew is a highly prevalent disease across all monitored production pockets in southern Rajasthan. Symptoms were easily recognized by the presence of white to greyish talcum-like fungal growth on upper leaf surfaces, which gradually spread to lower leaf structures and stems as the plants aged. Severe infections frequently caused leaf chlorosis, drying, and premature defoliation.

District and Block-Level Analysis

The collected data revealed considerable variation in infection parameters across the surveyed regions (p. 28). Overall, the combined mean field incidence stood at 48.65%, while the mean disease index was 40.85 PDI.

Table 2: District-wise Incidence and Severity of Powdery Mildew of Cucumber in Southern Rajasthan

District	Monitored Blocks	Disease Incidence (%)	Disease Severity (PDI)	Area Status
Udaipur	Bargaon, Bhinder, Girwa	41.8	34.6	Low-Infection Baseline
Chittaurgarh	Barisadri, Begun, Bhadesar	48.25	40.1	Moderate-Infection Tract
Banswara	Anandpuri, Arthuna, Garhi	55.9	47.85	High-Intensity Hotspot
Overall Mean		48.65	40.85	Regional Average

Banswara Block-Level Dynamics (Hotspot Zone)

Banswara district emerged as the primary hotspot zone in southern Rajasthan. It recorded the highest regional disease pressure, with a district-wide field incidence peaking at 55.90% and severity reaching a maximum of 47.85 PDI. At the block level, the highest field damage was concentrated in Anandpuri and Garhi. In these localities, dense crop canopies combined with favorable relative humidity levels enhanced microclimatic suitability, allowing for rapid fungal multiplication and quick spore germination. Structural damage in these blocks frequently manifested as advanced Grade 7 and Grade 9 leaf infections. The Arthuna block showed slightly lower infection levels but remained well above the regional average, confirming high pathogen activity across the entire district

Chittaurgarh Block-Level Dynamics (Moderate Zone)

Chittaurgarh district exhibited moderate, stable infection dynamics, displaying an average field incidence of 48.25% alongside a severity score of 40.10 PDI. Within this district, the Barisadri block experienced the highest infection pressure. Symptoms in this area spread rapidly during the mid-to-late reproductive stages, coating entire lower leaf frames before advancing upwards. The Begun and Bhadesar blocks showed moderate, uniform lesion development, indicating that local fields faced consistent and widespread spore accumulation over the course of the cropping cycle.

Udaipur Block-Level Dynamics (Low Baseline Zone)

Udaipur district showed the lowest baseline disease activity, recording a field incidence of 41.80% and a severity index of 34.60 PDI. At the micro-regional level, the Bargaon block recorded the lowest disease expression. This occurred as early-planted fields partially escaped peak spore dispersion. The Bhinder and Girwa blocks showed slightly higher values. In these blocks, lesions appeared primarily on older, lower leaves as isolated Grade 1 and Grade 3 specks before gradually moving upward into the younger plant canopy as ambient temperatures rose later in the season .The fact that overall disease incidence (48.65%) was higher than relative disease severity (40.85 PDI) indicates that while the pathogen successfully colonized a large percentage of cucumber plants, individual infection levels varied among fields.

Discussion

This study establishes that powdery mildew (E. cichoracearum) is actively distributed throughout the major

cucumber production zones of southern Rajasthan (pp. 28-29). The variations observed in disease incidence (41.80% – 55.90%) and severity (34.60 – 47.85 PDI) suggest that localized environmental conditions and microclimates heavily influence fungal colonization. The elevated infection rates in Banswara district point to high environmental compatibility and a substantial buildup of fungal spore inoculum in that region. These outcomes align closely with similar epidemiological assessments conducted across India. For instance, Gangwar and Mishra (2014) surveyed cucurbit tracts in eastern Uttar Pradesh and reported powdery mildew field incidence values ranging from 41.80% to 55.90%, with severity scores between 34.60 and 47.85 PDI. Additionally, our severity range matches the findings of Basavaraj (2018), who reported mean cucumber PDI values between 30.31% and 36.61% across three districts in northeastern Karnataka. Our field observations also reinforce the findings of Abbaiah (1993), who noted that powdery mildew establishes more aggressively during later crop growth phases. This pattern occurs because multiplying foliar lesions expand and merge as the crop reaches maturity, leading to the high PDI values recorded during late-season evaluations.

Conclusion

This systematic survey demonstrates that powdery mildew caused by *Erysiphe cichoracearum* is widely distributed and causes significant foliar damage to cucumber crops in southern Rajasthan. With an overall mean field incidence of 48.65% and a severity of 40.85 PDI, the disease presents a clear economic threat to local farmers. Block-level monitoring identified Banswara's Anandpuri and Garhi tracts as critical disease hotspots. These findings supply essential epidemiological data necessary for developing regional management strategies, timing protective fungicide applications, and introducing resistant cucumber cultivars to safeguard crop yields.

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