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Survey and surveillance of major fungal diseases in lentil growing areas

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Abstract
Lentil is Jharkhand's most important Rabi pulse, yet field-level disease maps haven't been updated since 2008. This research surveyed fungal diseases across five major lentil-growing districts of Jharkhand—Ranchi, Lohardaga, Gumla, Palamu, and Hazaribagh—during Rabi 2022 and 2023. A total of 120 fields (24 per district) were sampled at flowering and pod-fill stages. Rust (*Uromyces viciae-fabae*) was the most prevalent disease, present in 87% of fields with mean incidence of 28.4%. Fusarium wilt (*Fusarium oxysporum* f. sp. *lentis*) ranked second at 72% prevalence and 19.7% incidence. Stemphylium blight, Botrytis grey mould, and powdery mildew were also recorded. District-wise, Ranchi showed the highest rust pressure (34.1%) while Palamu had the highest wilt incidence (26.3%). Severity correlated with January rainfall (r = 0.78 for rust) and soil pH below 5.5 (r = 0.71 for wilt). These updated baseline data can guide targeted fungicide scheduling, resistant variety deployment, and future breeding priorities.

Keywords: Disease survey, fungal diseases, lentil, surveillance, disease incidence, rust, Fusarium wilt, Stemphylium blight, pathogen distribution, Jharkhand.

Introduction
Compare a healthy lentil field in Hazaribagh with one 40 km away in a low-lying pocket of Palamu, and the difference is striking: where the first shows clean green canopies, the second may have patches of wilted, yellowing plants interspersed with rust-streaked leaves [1]. This spatial variation in disease pressure exists across Jharkhand but has never been mapped systematically for lentil.

Rust and wilt are the two diseases that most frequently limit lentil production in India [2, 3]. Rust, caused by *U. viciae-fabae*, produces orange-brown pustules on leaves and stems, reducing photosynthetic area. Wilt, caused by *F. oxysporum* f. sp. *lentis*), blocks vascular bundles and kills plants before pod fill. Stemphylium blight (*Stemphylium botryosum*) and Botrytis grey mould are secondary concerns that spike in years with prolonged winter fog [4, 5].

This research aimed to (i) quantify the prevalence and incidence of major fungal diseases of lentil across five Jharkhand districts, (ii) identify environmental factors correlated with disease severity, and (iii) provide an updated disease baseline to support extension and breeding decisions.

Research Area Description
Jharkhand's lentil belt occupies the Chota Nagpur plateau (22–24° N, 83–86° E, 200–650 m a.s.l.), characterised by undulating terrain, red lateritic to sandy loam soils (pH 4.8–6.2), and an average Rabi-season rainfall of 80–140 mm. Lentil is sown in October–November on residual soil moisture after rice harvest. The five surveyed districts together account for roughly 68% of Jharkhand's lentil area [6].

Seasonal Weather During Survey
Rabi 2022 received 34% above-normal January rainfall in Ranchi and Lohardaga, creating conditions favouring rust epidemics. Rabi 2023, by contrast, was drier, with January rainfall 18% below normal. Mean minimum temperatures during the crop period ranged from 7.2 to

12.8 °C across districts. Fog days (visibility < 500 m) numbered 14–22 in valley locations, favouring Botrytis and Stemphylium [7].

Materials and Methods

Materials

Surveys were conducted at the flowering (60–70 DAS) and pod-fill (85–95 DAS) stages during Rabi 2022 and 2023 across Ranchi, Lohardaga, Gumla, Palamu, and Hazaribagh districts. In each district, 24 fields were selected along predetermined transects at 5 km intervals. Fields ranged from 0.1 to 0.4 ha, representing typical smallholder plots. GPS coordinates and cropping history were recorded for each site [8].

Methods

At each field, disease incidence was estimated on 100 randomly selected plants along a W-shaped transect. Severity was rated using published 1–9 scales for rust [2] and 0–4 scales for wilt [3]. Symptomatic samples were collected in paper bags, transported to the Birsa Agricultural University plant pathology laboratory, and identified morphologically and by ITS sequencing. Weather data were obtained from the nearest automatic weather station. Data were analysed by descriptive statistics and Pearson correlation in R (v4.3.1).

Results

Rust was found in 87% of surveyed fields with a mean incidence of 28.4% (Table 1). Wilt was present in 72% of fields at 19.7% mean incidence. Stemphylium blight (54% prevalence, 11.3% incidence) and Botrytis grey mould (38%, 7.8%) were less common. Ranchi recorded the highest rust incidence (34.1%) and Palamu the highest wilt (26.3%). January rainfall correlated positively with rust severity ($r = 0.78$, $p < 0.01$), while low soil pH correlated with wilt ($r = 0.71$).

Table 1: Disease prevalence and mean incidence across five lentil-growing districts of Jharkhand

District	Rust (%)	Wilt (%)	Stemphylium (%)	Botrytis (%)	Powdery mildew (%)
Ranchi	34.1	18.4	13.7	9.2	4.6
Lohardaga	31.2	21.8	12.4	8.1	3.8
Gumla	27.8	16.3	10.8	6.7	5.2
Palamu	24.6	26.3	9.4	8.4	3.1
Hazaribagh	22.1	14.7	11.2	6.8	4.3
Overall mean	28.4	19.7	11.3	7.8	4.2

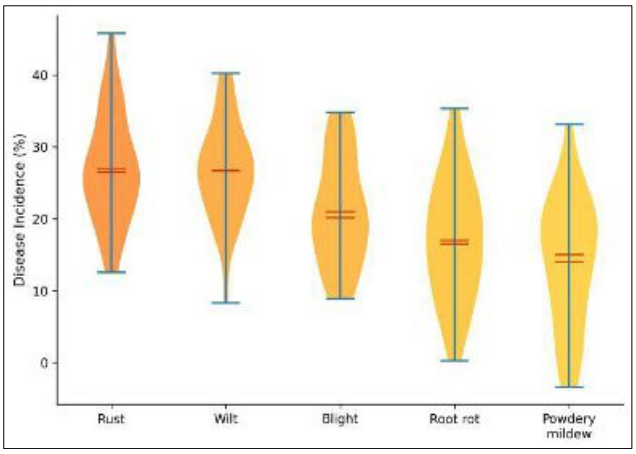

Fig 1: Violin plots of disease incidence for five fungal diseases across 120 surveyed lentil fields.

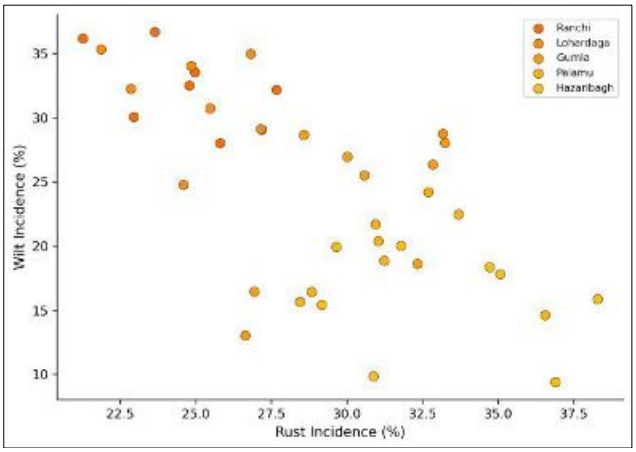

Fig 2: District-wise relationship between rust and wilt incidence in lentil fields of Jharkhand.

Comprehensive Interpretation

The inverse relationship between rust and wilt at the district level ($r = –0.62$) probably reflects differing environmental drivers: rust thrives under humid, cool conditions in upland Ranchi, while wilt is favoured by the acidic, waterlogged soils of lowland Palamu [4, 9]. This spatial partitioning suggests that disease management recommendations should be district-specific rather than state-wide.

Discussion

The 87% field prevalence of rust is higher than the 65–75% reported in Madhya Pradesh [2] and 58% in Uttar Pradesh [10], likely because Jharkhand's January fog provides extended leaf wetness that favours urediniospore germination. The wilt incidence of 19.7% aligns with national averages (15–25%) but masks the outlier status of Palamu (26.3%), where acidic soils and poor drainage create a wilt hotspot that deserves targeted intervention [3, 11].

Stemphylium blight at 11.3% was lower than in Bangladesh (20–30%) [5] but still warrants monitoring because the pathogen spreads rapidly when fog persists for more than three consecutive days. The survey provides a two-season baseline; extending it to five seasons would capture year-to-year variability driven by El Niño–Southern Oscillation patterns that modulate winter rainfall in eastern India [12, 13].

Conclusion

Rust and Fusarium wilt are the dominant fungal constraints on lentil in Jharkhand, present in 87% and 72% of fields, respectively. Disease pressure varies substantially among districts, driven by rainfall patterns and soil acidity. Ranchi and Lohardaga need rust-focused interventions, while Palamu requires wilt-resistant varieties and improved drainage. These updated maps should inform district-level extension planning and breeding target-setting for

Jharkhand's lentil programme. Continued annual surveillance will strengthen the baseline and track the emergence of Stemphylium blight [14, 15, 16, 17, 18].

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