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Research Article

THE MAGNITUDE OF ASCOCHYTA BLIGHT OF CHICKPEA AND ITS RELATIONSHIP WITH PREVAILING ENVIRONMENTAL CONDITIONS IN THE THAL REGION OF PUNJAB, PAKISTAN

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ABSTRACT

This study assessed Ascochyta blight disease in chickpea across five districts in the 'Thal' region of Punjab, Pakistan: Bhakkar, Jhang, Layyah, Muzaffargarh, and Mianwali. The disease prevalence, incidence, and severity were recorded over two consecutive years, 2020-2021 and 2021-2022, during the chickpea-growing season. Disease prevalence ranged from 76% in Layyah to 40% in Muzaffargarh. Layyah also exhibited the highest disease incidence (84.2%) and severity (59.41%), while Muzaffargarh recorded the lowest disease incidence (20.55%) and severity (8.55%). All thirty-seven fungal isolates obtained from diseased samples were morphologically identified as *Ascochyta rabiei*. Twenty-five isolates, including five representatives from each district, were characterized based on their pathogenicity. The isolate ARL1 from Layyah exhibited the highest pathogenicity, with disease rating scores of 8.5 in detached leaf assays and 7.3 in attached leaf assays. Pathogen virulence showed a positive relationship with the disease intensity observed in the respective districts. Disease incidence and severity were further correlated with various prevailing environmental factors in these districts. Disease incidence was positively correlated with relative humidity and wind speed, while disease severity showed a positive correlation with relative humidity and rainfall but a negative correlation with maximum temperature. Other epidemiological factors did not exhibit significant relationships with the disease. This study concludes that the 'Thal' region is highly threatened by Ascochyta blight disease due to relatively higher relative humidity, rainfall, wind speed, and fungal virulence. Therefore, proper and timely management practices are essential to mitigate the impact of Ascochyta blight disease and address these influencing factors effectively.

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INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a significant legume crop cultivated in subtropical, temperate, desert, and semiarid environments, characterized by low water requirements (Zhang et al., 2020). Chickpea seeds offer a highly beneficial nutritional profile for a balanced human diet, containing 19.3% protein, 43.3% sugars, 6% fats, and

substantial levels of iron, zinc, and essential vitamins such as A, B2, B6, and B9 (Grasso et al., 2022). Globally, chickpea occupies 14.84 million hectares of cultivated land, with an annual production of approximately 15 million tons (FAOSTAT, 2021).

In Pakistan, chickpea is cultivated on about 2.2 million hectares, with 80% of the area located in the 'Thal' region of Punjab (www.aari.punjab.gov.pk). High-yielding chickpea varieties, such as 'Noor 19' (2900 kg/ha) and 'Noor 23' (3413 kg/ha), have been developed by the Pulses Research Institute in Faisalabad. However, no variety has yet been developed that is completely resistant to blight disease (www.aari.punjab.gov.pk). Achieving the full yield potential of these varieties remains dependent on effective disease management.

Effective control of blight disease requires continuous monitoring of the changing climate in chickpea-growing regions, assessing the relationship between environmental conditions and disease dynamics, and identifying other factors contributing to disease outbreaks. These measures are essential for implementing appropriate and timely control strategies (Shahzaman et al., 2025; Mahmood et al., 2018; Sunkad et al., 2019).

Ascochyta blight was first identified in 1911 in the North-West Frontier Province of India (now part of Pakistan) (Pande et al., 2005). Since then, it has spread to major chickpea-growing regions worldwide, affecting over 40 countries across western Asia, southern Europe, and northern Africa. Ascochyta blight, caused by the fungus *Ascochyta rabiei*, is a common but devastating disease of chickpeas, impacting all parts of the plant, including leaves, fruits, and stems (Rubiales et al., 2018). The blight causes spots that rapidly enlarge, leading to necrosis, tissue disintegration, and, ultimately, the death of organs or the entire plant (Duzdemir et al., 2014). A conducive environment plays a critical role in the disease triangle and is essential for disease development (Khan and Abid, 2007). Ascochyta blight can result in complete crop failure under favorable cool and wet conditions (Reddy and Singh, 1990).

Chickpea blight is reported to be favored by high humidity and cold temperatures ranging from 5 to 15°C. However, pycnidia can survive for more than two years in crop residues under conditions of 10-35°C with high relative humidity (Oliveira et al., 2017). At all stages of the crop cycle, from seedling to pod formation, temperatures between 22 and 26°C combined with heavy rainfall can exacerbate disease severity (Trapero-Casas and Kaiser, 1992). Crop stubble, seeds, leaves, insects, and other animals contribute to fungal dispersal. Moreover, some insecticides have been reported to promote fungal mycelial growth, potentially increasing the spread of fungal infection (Chohan et al., 2018). Wind plays a significant role in carrying spores from infected to healthy plants throughout the crop season, facilitating the spread of the disease across fields or regions (Motagi et al., 2020).

To effectively disrupt the disease cycle, it is crucial to identify epidemiological changes, assess their impact on disease progression, and understand variations in the pathogenicity of associated fungi (Barilli et al., 2016; Tadesse et al., 2017). Although some surveys have been conducted in chickpea-growing areas, limited efforts have been made to comprehensively understand the prevalence and impact of Ascochyta blight, its geographical distribution, and its environmental associations in the main chickpea cultivation regions of Pakistan.

Ascochyta blight is a recurring problem in chickpea-growing regions of Pakistan. Conducting an extensive study can provide understandings for its prevalence and facilitate disease management by examining the association between disease incidence, severity, and epidemiology. Such understanding could help identify critical factors and establish sustainable management measures (Ratnadass et al., 2012). The present research aimed to: 1) record the disease prevalence, incidence, and severity in the 'Thal' region of Punjab, Pakistan; 2) identify the associated fungal pathogen and characterize it based on pathogenicity; and 3) examine the relationship between the disease and prevailing environmental factors.

MATERIALS AND METHODS

Survey area

A survey of chickpea blight disease was conducted across five districts, Bhakkar, Jhang, Layyah, Muzaffargarh, and Mianwali, in the 'Thal' region of Punjab, Pakistan (30°59'-32°6' N and 71°14'-72°16' E) (Figure 1) during the chickpea growing seasons (November to March) of two consecutive years: 2020-2021 and 2021-2022. A total of 25 chickpea fields, comprising five fields from each district, were selected and assessed for disease incidence and severity throughout each growing season. Additionally, 10 to 12 fields were randomly evaluated in each district to calculate disease prevalence. The spatial and temporal distribution of Ascochyta blight was thoroughly examined.

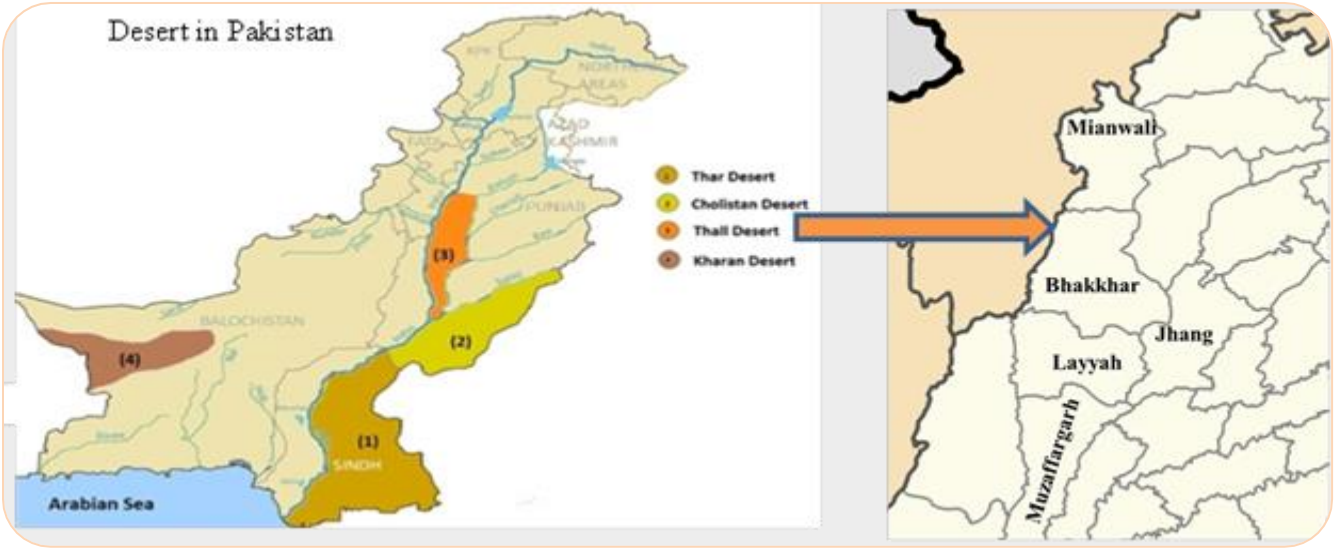

Figure 1. Map showing the deserts of Pakistan and the five districts selected for the current study within the Thal desert of Punjab province, Pakistan.

Disease assessment

Each chickpea field was assessed for the prevalence, incidence, and severity of blight disease by evaluating distinct lesions on leaves, stems, and pods. Disease incidence in each field was measured using a 1 m × 1 m (1.00 m^2) quadrat positioned along the two diagonals in an "X" pattern. The number of sampling points ranged from 7 to 9, depending on the field size. Chickpea plants within each quadrat were counted and categorized as either healthy or displaying disease symptoms. The disease severity level for each field was determined using a rating scale from 0 to 9, modified from the work of Nene et al. (1981). The scale includes the following nine categories:

1. No visible lesions,
3. Flecks on leaves,
5. Flecks on leaves and lesions on stems,
7. Stems breaking at the damaged areas and
9. Plant death

Disease prevalence, incidence, and severity were calculated using formulas described by James (1974) and Singh et al. (2011).

$$\text{Disease prevalence (\%)} = \frac{\text{Number of affected field}}{\text{Total fields assessed}} \times 100$$

$$\text{Disease incidence (\%)} = \frac{\text{Number of diseased plants}}{\text{Total number of observed plants}} \times 100$$

$$\text{Disease severity (\%)} = \frac{\text{Total of the ratings in numbers}}{\text{Number of plants observed} \times \text{maximum scale}} \times 100$$

Disease samples

Diseased plant parts, including leaves, pods, and stems exhibiting Ascochyta blight symptoms such as concentric rings and pycnidial growth, were randomly collected from fields in all five districts (Table 1, Figure 2) within the selected survey areas of 'Thal', Punjab (Figure 1). The samples were transported to the Fungal Ecology and Biocontrol Laboratory, Bahauddin Zakariya University, Multan, Pakistan, for fungal isolation, morphological identification, and pathogenicity characterization. The fungal cultures were maintained in 90 mm diameter Petri plates containing sterilized gram seed meal agar (GSMA) medium, composed of 20 g gram seed meal, 20 g agar, 20 g glucose, and 1 L of sterilized water.

Fungal isolation

Seventy-four collected samples containing various infected plant parts were surface-sterilized with 1% sodium hypochlorite solution (NaOCl), thoroughly rinsed with distilled water, and air-dried in a sterile environment. The sterilized plant parts were then placed in Petri plates containing GSMA medium and incubated at 20 ± 2°C for 15 days until sporulation occurred. The fungal strains were isolated and purified using the single spore technique (Noman et al., 2018) and subsequently sub-cultured with a sterile glass needle under aseptic conditions. The sub-cultured isolates were further incubated at 20 ± 2°C for 15 days under alternating light and dark periods.

Table 1. Details of diseased samples, plant parts, and pure isolates of *A. rabiei* collected from 25 fields across five districts in the Thal desert, Punjab Province, Pakistan.

Districts	No. of field visited	No. of diseased sample			No. of *A. rabiei* isolates
		Leaves	stem	pods	
Muzaffargarh	5	17	2	3	8
Layyah	5	20	15	8	7
Jhang	5	21	12	5	9
Bhakkar	5	22	16	0	8
Mianwali	5	19	8	3	5

Figure 2. Characteristic symptoms of Ascochyta blight disease: (a) infected mature pod, (b) infected leaves, and (c) infected branches.

Morphological identification

The fungal isolates of *Ascochyta rabiei*, associated with Ascochyta blight, were identified based on morphological characteristics, including colony growth, morphology, color, and spore shape and size, as described by Bahr et al. (2016) and Crociara et al. (2022). These isolates were deposited in the Culture Bank of the Fungal Ecology and Bio-Control Laboratory at the Department of Plant Pathology, Bahauddin Zakariya University, Multan, Pakistan.

Pathogenicity test

Isolates exhibiting colonial morphology consistent with the majority of isolates from the same locality were selected as representatives for each district. Five representative isolates, one from each field, were chosen and characterized based on their pathogenicity tests using both attached and detached leaf assays.

Detached leaf assay

The chickpea cultivar "Bittle-92", known for its susceptibility to Ascochyta blight, was cultivated in pots filled with a mixture of garden soil and perlite in a 3:1 ratio. The pathogenicity of each representative isolate was evaluated using a detached leaf test, following the methodology outlined by Riaz et al. (2021).

For the pathogenicity test, representative isolates were cultured on GSMA medium for 15 days at 20 ± 2°C under alternating light and dark conditions. The plant material used in the experiment comprised healthy leaves collected from 30-day-old plants. The leaves were detached from the petiole base and disinfected with a 2% sodium hypochlorite solution for 2 min. Following disinfection, the leaves were rinsed three times with sterilized distilled water and air-dried on tissue paper inside a laminar flow chamber.

Sterile Petri plates (90 mm diameter) containing sterile Whatman filter paper no. 1 were prepared. The dried leaves were individually placed in the Petri plates, ensuring that the abaxial side was oriented vertically. Inoculation involved puncturing each leaf and introducing a 5-mm mycelial agar plug, taken from the margin of a 15-day-old culture grown on GSMA medium, into each Petri plate.

To maintain humidity, 2 ml of water was added to each Petri plate, and the plates were incubated at 20 ± 2°C. Three replicates were prepared for each fungal isolate

to ensure data accuracy. Disease severity was evaluated using a rating scale modified from Nene et al. (1981). Based on disease scores, the isolates were categorized as follows:

Scores above 7: Highly pathogenic,
Scores from 5 to 7: Pathogenic with minor symptoms,
Scores from 3 to 5: Moderately pathogenic and
Scores from 1 to 3: Less pathogenic

Attached leaf assay

The pathogenicity was verified using an attached leaf assay, following the methodology outlined by Reddy (1984). The experiment was conducted in a greenhouse under controlled conditions with 30-day-old chickpea plants. For the assay, three leaves were selected from each of three plants. Mycelial plugs (5 mm in diameter) were obtained from a 15-day-old fungal culture, suspended in 1 ml of sterilized water, and spores were counted at a concentration of 1×10^5 using a hemocytometer. The spore suspension was applied to pierced and disinfected leaves. Disease severity was assessed and scored after symptom development using the rating scale mentioned earlier.

Environmental data

Weather parameters, including maximum and minimum temperatures, rainfall, relative humidity, and wind speed, were collected from www.weather-atlas.com, www.timeanddate.com, and www.weather2visit.com for two consecutive years (2020-2021 and 2021-2022). The mean weather parameter data for each district are presented in Table 2.

Table 2. Mean data for different weather parameters across two consecutive years (2020-2021 and 2021-2022) in five districts of Thal, Punjab, Pakistan.

Environmental Variables	Districts				
	Muzaffargarh	Layyah	Jhang	Bhakkar	Mianwali
Minimum Temperature (°C)	11.9	7.5	4.2	5.4	16.3
Maximum Temperature (°C)	26.3	25.3	25.4	23.8	26.7
Rainfall (mm)	1	11.6	9	8	2
Relative Humidity (%)	29	73	60	57	28
Wind speed (km/h)	6.6	2	11	1.8	5.9

Data analysis

The data obtained from the field survey and greenhouse experiments were analyzed using Analysis of Variance (ANOVA) and Fisher's Least Significant Difference (LSD) test at a 0.05% significance level to distinguish between the means of different treatments. The statistical program Statistix 8.1 (McGraw-Hill, 2008) was used. Pearson correlation was performed to assess the impact of climatic conditions on disease incidence and severity.

RESULTS

Prevalence of chickpea blight in the 'Thal' area of Punjab, Pakistan

The prevalence of Ascochyta blight in chickpea crops is shown in Figure 3. The highest mean disease prevalence was recorded in Layyah (76%), followed by Jhang (64%), Bhakkar (56%), Mianwali (40%), and Muzaffargarh, which had the lowest disease prevalence (34%) (Figure 3). The highest disease incidence was observed in Layyah (84.2%), followed by Jhang (70.71%), Bhakkar (52.62%), Mianwali (40.52%), and Muzaffargarh (20.55%) (Figure 4). The highest disease severity was recorded in Layyah (59.41%), followed by Jhang (42.84%), Bhakkar (33.30%), Mianwali (21.61%), and Muzaffargarh (8.55%) (Figure 5).

Fungal species associated with Ascochyta blight disease

All the isolates were identified as *A. rabiei* associated with the diseased samples collected during the survey. The colonial morphology of *A. rabiei* mycelium on GSMA media exhibited a smooth, circular to irregular pattern and a greenish-brown coloration. The conidia were hyaline, ranging from oblong to oval in shape, rigid or slightly curved at both ends, and measured 6-12 × 4-6 µm, which are distinctive features of *A. rabiei*. The conidia had a single transverse septum and lacked any longitudinal septum. Thirty-seven pure isolates were obtained from the surveyed fields, as shown in Table 1. Five isolates were selected from each location, ensuring that the conidial morphology was consistent with that of all other isolates from the particular locality. In total, twenty-five representative isolates were selected.

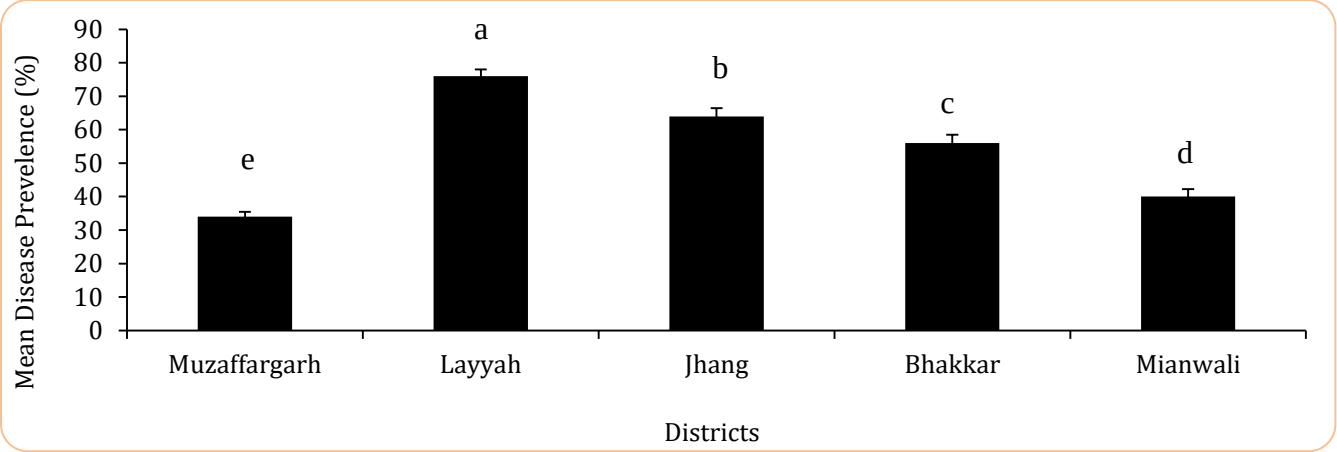

Figure 3. Mean disease prevalence (%) for the two consecutive years, 2020-2021 and 2021-2022, recorded in five districts of Thal, Punjab, Pakistan. The standard deviation is represented by the error bars. The LSD test at $p \leq 0.05$ indicates that means with different letters are statistically different.

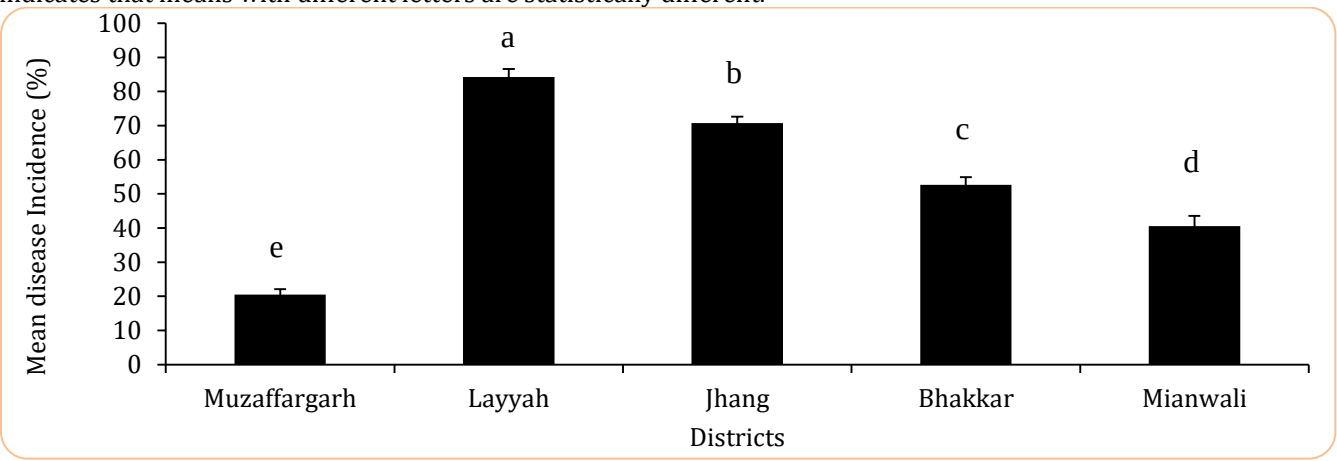

Figure 4. The mean disease incidence (%) for the two consecutive years, 2020-2021 and 2021-2022, recorded in five districts of Thal, Punjab, Pakistan. Standard deviation is represented by the error bars. The LSD test at $p \leq 0.05$ indicates that means with different letters are statistically different.

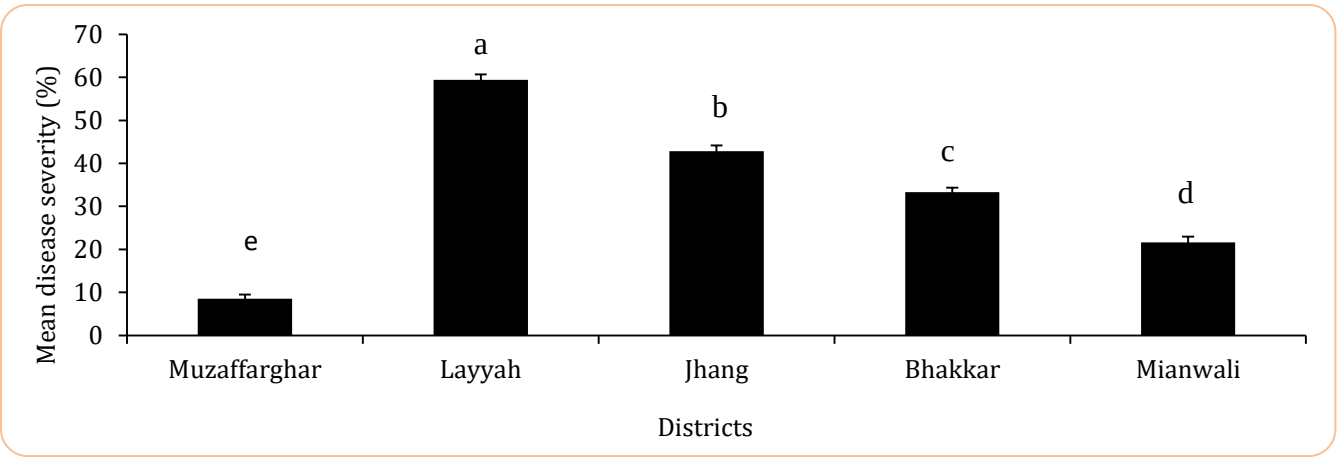

Figure 5. Mean disease severity (%) for the years 2020-2021 and 2021-2022 recorded in five districts of Thal, Punjab, Pakistan. Standard deviation is shown by the error bars. The LSD test at $p \leq 0.05$ indicates that means with different letters are statistically different.

Pathogenicity variation among *A. rabiei* isolates

All twenty-five isolates were pathogenic and caused necrotic lesions on detached leaves with varying levels of pathogenicity. The isolate ARL1 was classified as highly pathogenic (8.5), resulting in extensive necrosis or chlorosis on detached leaves. Detailed pathogenicity test results are presented in Figure 6, Figure 7, and Table 3. The pathogenicity test was also confirmed on attached leaves, where it was classified as highly pathogenic (7.3). The results were consistent between both assays, and there was a significant difference in pathogenicity (Figure 6, 7, and Table 3).

Figure 6. Pathogenicity test of *A. rabiei* (ARL1) on detached leaves: (a) Healthy plant, (b) Healthy vs. symptomatic leaves, (c) *A. rabiei* colony on GSMA media.

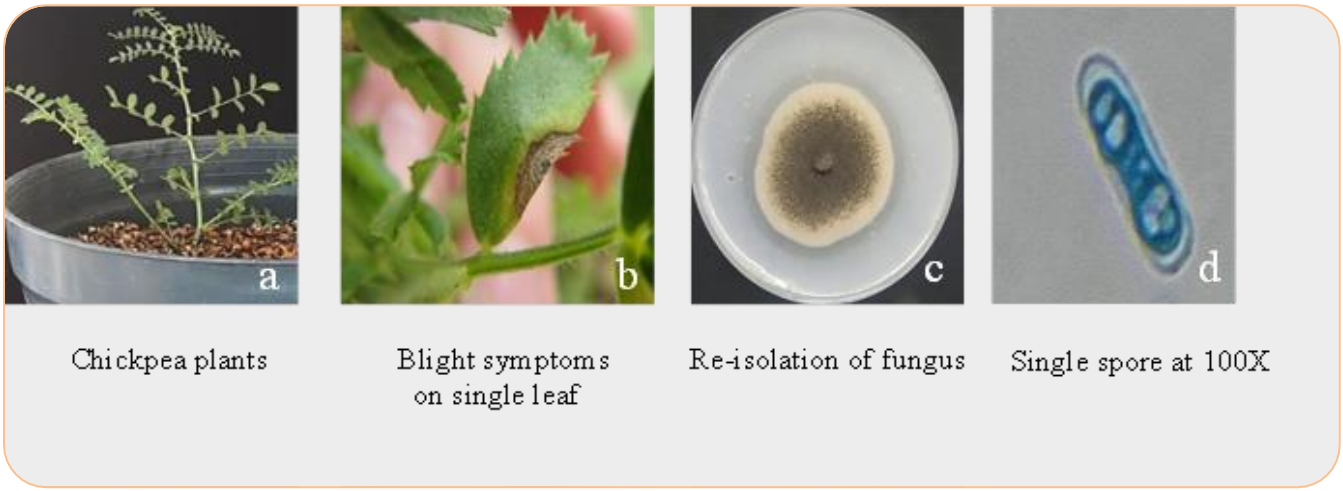

Figure 7. Pathogenicity test of *A. rabiei* (ARL1) on an attached leaf: (a) Inoculated chickpea plants, (b) Infected plant showing characteristic symptoms, (c) Reisolated *A. rabiei* (ARL1) colony on GSMA medium, (d) Single conidium of *A. rabiei* under the microscope at 100×.

Correlation analysis between weather parameters and Ascochyta blight disease

Pearson correlation analysis was conducted to examine the impact of climatic factors on disease incidence and severity. The average data from two consecutive years indicated that disease incidence had a positive correlation with mean relative humidity (r = 0.7214*) and wind speed (r = 0.5943*). Disease severity showed a positive correlation with relative humidity (r = 0.7453*) and rainfall (r = 0.791*), but a negative correlation with maximum temperature (r = -0.7643*). Other factors did not show any significant relationship with disease incidence or severity (Table 4).

Table 3. Pathogenicity test results of *A. rabiei* isolates on detached and attached leaf assays, where ± represents the standard error. The isolates are categorized as less pathogenic < pathogenic < moderately pathogenic < highly pathogenic.

Sampling districts	Isolate coding	Mean disease severity rating on detached leaf assay	Mean disease severity rating on attached leaf assay	Categorization
Muzaffargarh	ARM1	2.8 ± 0.55	1.9 ± 0.67	Less pathogenic
Muzaffargarh	ARM2	2.4 ± 0.22	2.1 ± 0.27	Less pathogenic
Muzaffargarh	ARM3	1.8 ± 0.54	1.2 ± 0.24	Less pathogenic
Muzaffargarh	ARM4	3.1 ± 0.41	3.3 ± 0.67	Moderately
Muzaffargarh	ARM5	2.6 ± 0.33	2.5 ± 0.77	Less pathogenic
Layyah	ARL1	8.5 ± 0.64	7.3 ± 0.89	Highly pathogenic
Layyah	ARL2	8.0 ± 0.44	7.3 ± 0.49	Highly pathogenic
Layyah	ARL3	7.7 ± 0.24	7.2 ± 0.32	Highly pathogenic
Layyah	ARL4	6.8 ± 0.12	5.3 ± 0.23	Pathogenic
Layyah	ARL5	8.1 ± 0.14	7.4 ± 0.32	Highly pathogenic
Jhang	ARJ1	7.0 ± 0.12	6.0 ± 0.23	Pathogenic
Jhang	ARJ2	5.5 ± 0.12	5.0 ± 0.13	Pathogenic
Jhang	ARJ3	4.8 ± 0.32	4.0 ± 0.23	Less Pathogenic
Jhang	ARJ4	8.1 ± 0.14	7.4 ± 0.32	Highly Pathogenic
Jhang	ARJ5	3.0 ± 0.42	4.0 ± 0.23	Moderately
Bhakkar	ARB1	6.2 ± 0.33	5.5 ± 0.76	Pathogenic
Bhakkar	ARB2	4.2 ± 0.23	4.2 ± 0.46	Moderately
Bhakkar	ARB3	7.0 ± 0.33	6.5 ± 0.36	Pathogenic
Bhakkar	ARB4	6.3 ± 0.23	4.5 ± 0.86	Pathogenic
Bhakkar	ARB5	6.6 ± 0.55	4.4 ± 0.23	Pathogenic
Mianwali	ARMI1	5.0 ± 0.54	3.9 ± 0.90	Moderately
Mianwali	ARMI2	3.8 ± 0.34	3.4 ± 0.20	Moderately
Mianwali	ARMI3	4.6 ± 0.21	4.1 ± 0.33	Pathogenic
Mianwali	ARMI4	2.7 ± 0.24	2.4 ± 0.11	Less Pathogenic
Mianwali	ARMI5	5.6 ± 0.44	4.4 ± 0.88	Pathogenic

DISCUSSION

The present research highlights an alarming situation regarding the occurrence of Ascochyta blight disease in the 'Thal' area of Punjab, with incidence percentages ranging from 21% to 84% and severity ranging from 9% to 59%. These findings underscore the substantial incidence and severity of the disease, with significant variation across different geographical locations within the 'Thal' region. One of the major reasons for such high disease incidence may be monocropping, as the highest disease prevalence and incidence were observed in Layyah, the heart of chickpea farming (Addisu et al., 2023). The main factors contributing to the high incidence and severity of the disease include the presence of pathogenic *A. rabiei* strains responsible for chickpea blight and contributing environmental factors (Singh et al., 2022). The survival and dissemination capabilities of *A. rabiei*, as its life cycle involves both seed and airborne phases, is another important factor to consider. This characteristic makes the disease challenging to manage using physical methods such as crop rotation and sanitation (Dell'Olmo et al., 2023).

In this study, all the fungal isolates associated with the diseased samples were identified as *A. rabiei*. Pathogenicity-based characterization revealed significant differences depending on the origin of the isolates, as well as the disease incidence and severity in the respective regions. These differences reflect variations in the expression of severity and host colonization, even though all pathogens were subjected to the same conditions

(Oguiba et al., 2023). Nearly all the pathogens exhibited similar behavior, with a few exceptions. Pathogenicity differences among fungal isolates observed in the detached leaf assay were confirmed in the attached leaf assay *in planta*. The small difference between the two assays may be due to the fact that detached leaves often provide a less favorable environment for pathogens, leading to lower pathogenicity compared to attached leaves (Beattie and Lindow, 1995). Consistent results between the attached and detached leaf assays validated the pathogenicity findings. The detached leaf assay is a quick and space-efficient method that is unaffected by variables such as greenhouse or field conditions (Özer et al., 2018; Riaz et al., 2021).

Table 4. Correlation analysis of climatic factors on disease incidence and severity in two consecutive years (2020-2021 and 2021-2022).

Variables	Disease incidence	Disease severity
Minimum Temperature (°C)	0.2212	-0.0643
Maximum Temperature (°C)	-0.2333	-0.7643*
Rainfall (mm)	0.0141	0.791*
Relative humidity (%)	0.7214*	0.7453*
Wind speed (km/h)	0.5943*	-0.1832

(*) Significant, Correlation is significant at p ≤0.05.

Furthermore, the current study investigated the weather parameters of the region over two consecutive years during the chickpea growing season (November to March) to assess their role in disease spread. Monitoring climatic conditions for at least three months is essential, given the significance of primary inocula, such as stubble- or seed-borne forms, in the severity of Ascochyta blight outbreaks (Salam et al., 2011). Alternating wet and dry conditions in districts like Layyah, Jhang, and Bhakkar appeared conducive to the development of Ascochyta blight. Studies show that the prevalence and spread of the disease are significantly influenced by factors such as relative humidity, temperature, and wind (El Jarroudi et al., 2017; Tadesse et al., 2017). Layyah recorded the highest disease incidence and severity, with 76% and 59.41%, respectively. The temperature in Layyah ranged from 7.5°C to 25.3°C, with a relative humidity of 73%, and it experienced the highest level of rainfall (11.66 mm). In contrast, Muzaffargarh showed the lowest disease severity at 8.55%, with temperatures ranging from 11.9°C to 26.3°C and a relative humidity of 29% (Table 2). The correlation of environmental parameters revealed that relative humidity, rainfall, wind speed, and temperature played significant roles in disease spread in these regions. Haware and Nene (1981) reported that minimum temperature is crucial for the latent period, fungal sporulation, disease establishment, symptom development, and spore release. Rainfall is also necessary for the development of diseases and fungal sporulation because it maintains temperature and moisture on the plant surface (Mehmood et al., 2013).

The increase in maximum temperature reduced the severity, while rainfall and relative humidity promoted the pathogen's severity expression on plants, ultimately leading to greater disease severity. Relative humidity is a critical factor influencing the development of Ascochyta blight, with a significant association observed between humidity and both disease severity and incidence. Relative humidity triggers the release of ascospores from the ascus by altering the equilibrium between the water in the ascus and the water in the atmospheric vapor phase (Khanna et al., 2022). Minimum temperature and wind speed did not affect disease severity on plants. However, relative humidity and wind speed were found to have a positive correlation with disease incidence, thus promoting its occurrence in the current study. The impact of all these correlating factors on disease incidence and severity is reflected in the results of the current study. These environmental variations promote disease transmission, resulting in greater disease incidence and severity in these areas (Khan and Abid, 2007; Altaf et al., 2018). These factors are crucial in the development of disease in field crops. Consequently, understanding the relationship between these environmental variables and the severity of Ascochyta blight is essential for providing early warnings of its occurrence.

CONCLUSION

The study concludes that Ascochyta blight of chickpea requires urgent attention due to its high prevalence, incidence, and severity in the 'Thal' region of Punjab, Pakistan. *Ascochyta rabiei* is the pathogenic fungus associated with the disease, and it exhibits significant variation in pathogenicity depending on its origin. Pathogenicity and environmental factors, particularly maximum temperature, relative humidity, rainfall, and wind speed, played a crucial role in the spread of the

disease in these regions. All of these factors should be considered when developing an effective disease management strategy. Moreover, factors such as monocropping and fungicide resistance should be addressed in future studies.

AUTHORS' CONTRIBUTIONS

MA and SC designed, formulated, and laid out the study and supervised the work; HMS conducted the experiments, collected data, arranged and analyzed the data, and wrote the first draft. All the authors wrote and proofread the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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