The Bioscan
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
21(1): 271-281, 2026 www.thebioscan.com

Survey of Alternaria leaf blight incited by *Alternaria alternata* for dissease severity under different Isabgol growing agro-climatic regions

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DOI: 10.63001/tbs.2026.v21.i01.pp271-281

Keywords
Isabgol, Plantago ovata, Alternaria blight, Alternaria alternata, disease severity, roving survey, agro-climatic variability, epidemiology

Received on:

15-11-2025

Accepted on:

12-12-2025

Published on:

14-01-2026

ABSTRACT

A roving survey was conducted during the *Rabi* seasons 2023–24 and 2024–25 to assess the geographic variation in disease severity of Alternaria blight caused by *Alternaria alternata* across twenty locations representing diverse agro-climatic regions. Survey revealed a wide range of disease severity, with the average per cent disease severity (PDS) varying from 2.15 to 16.11 per cent, indicating considerable spatial variability in disease severity. This disease was prevalent in all surveyed locations, confirming the widespread distribution of the pathogen. The highest disease severity was recorded at Jinjinyala, Jodhpur, Rajasthan (16.11%), which was statistically at par with Medicinal and Aromatic Plant Garden, Anand, Gujarat (14.95%) and BRC Farm, Jodhpur (14.52%). A moderately high disease severity group comprised Menar F-1, Udaipur (13.47%), Khambolaz village, Anand (12.54%), ARS Farm, Mondor (12.23%), Kalakh, Jobner (12.20%), and Main Experimental Farm, Hisar (12.13%), which were statistically comparable, indicating similar epidemiological conditions favorable for disease development. Moderate disease severity was observed at Kunjrao village, Anand (11.65%), Manpuriya F-1, Mandsaur (11.37%), RCA Farm, Udaipur (11.32%), and Ranchhodpura village, Anand (11.23%), while lower disease intensity was recorded at Baori, Nagaur (9.88%), ANDUAT, Ayodhya (9.74%), MAPB at NRC on Seed Spices, Ajmer (8.80%), RVSKVV, Mandsaur (8.30%), and KVK Tabiji Farm, Ajmer (7.98%). The minimum disease severity was observed at Haripura, Jaipur (5.56%), Bhainslana, Jobner (4.26%), and Bhookhronki Dhani, Jobner (2.15%).

Introduction

Isabgol (*Plantago ovata* Forsk.), commonly known as psyllium, is an economically important medicinal and industrial crop belonging to the family Plantaginaceae. It is widely cultivated in arid and semi-arid regions of India, particularly in Rajasthan and Gujarat, due to its adaptability to low-moisture conditions and sandy loam soils. The crop is primarily valued for its seed husk, which contains high-quality mucilage comprised mostly of hemicelluloses and polysaccharides, making it an essential ingredient in pharmaceutical formulations, food industries, and nutraceutical products (Madgulkar *et al*., 2015). Owing to its therapeutic properties, psyllium is extensively used in the preparation of bulk-forming laxatives, fiber supplements, and various dietary formulations (Morita *et al*., 1999; Yu *et al*., 2008).

India holds a dominant position in the global psyllium market, contributing nearly 90–95% of the world's production and export (Maiti, 2000). According to the Department of Commerce (2023), India exported psyllium husk worth ₹265.8 crores and seeds worth ₹36.8 crores during 2022–23. The crop covers approximately 4.5 lakh hectares with an annual production of 4.32 lakh metric tonnes (Anonymous, 2023). Despite this substantial economic significance, isabgol is highly susceptible to several fungal diseases that severely limit its productivity and quality.

Among the important diseases affecting Isabgol, Downy mildew**,** Alternaria leaf blight**,** and Fusarium wilt are considered the most devastating diseases. In which Alternaria leaf blight, caused by *Alternaria alternata*, is an emerging necrotrophic disease known to cause severe foliar lesions, premature defoliation, and significant reduction in seed yield. *Alternaria* species are characterized by dark-colored, multicellular conidia with transverse and longitudinal septa, allowing rapid dissemination and survival under adverse conditions (Barnett & Hunter, 1998; Humpherson-Jones, 1985). In several crops, *A. alternata* has been reported to cause substantial economic losses due to its high pathogenicity and adaptability (Mamgain *et al*., 2013; Choudhary *et al*., 2024). *Alternaria alternata* is known to cause significant yield losses in several agricultural and medicinal crops (Choudhary *et al*., 2024). Although various studies have reported disease incidence in isolated regions, comprehensive multi-location surveys assessing the severity of Alternaria leaf blight**.** In Rajasthan, only a few studies have documented on Alternaria leaf blight (Bajya *et al*., 2017; Choudhary *et al*., 2021). The prevalence and distribution of diseases in Isabgol-growing belts are influenced by fluctuating climatic conditions, soil properties, agronomic practices, and pathogen inoculum levels. Given the environmental variability of arid regions and the absence of disease-resistant varieties, region-specific epidemiological data is essential for developing effective management strategies (Vennila *et al*., 2020).

Therefore, the present investigation was undertaken to conduct a systematic multi-location survey to determine the prevalence, distribution, and per cent disease severity of Alternaria blight of Isabgol across major growing locations during two consecutive Rabi seasons (2023-24 and 2024-25). The findings aim to provide baseline epidemiological information that will support disease forecasting, hotspot identification, resistance breeding, and integrated disease management (IDM) programs.

MATERIALS AND METHODS

Survey of major diseases of Isabgol from different agro-climatic region

Survey was conducted during two consecutive *Rabi seasons* from January to March in (2023-24 and 2024-25) for assessing the prevalence and occurrence of major diseases of Isabgol like downy mildew, alternaria blight, and fusarium wilt across major Isabgol growing regions (Uttar Pradesh, Haryana, Rajasthan, Gujarat). A total of 20 locations representing the major Isabgol growing areas were selected for the survey. These locations cover varying climatic and soil conditions typical of Isabgol cultivation regions. In each location, fields were selected randomly, within each field; five spots of one square meter area were marked diagonally to represent the entire field uniformly. Infected samples were collected from surveyed field. These samples were brought to laboratory for isolation of pathogens and further studies. All plants within each selected area were examined. Aim of survey was to explore possibility of existence of different genus and their morphological and molecular variability in pathogen isolates.

Observation

1. The per cent disease severity was recorded visually using a 0–5 disease rating scale.

Table 1: Alternaria disease rating scale (Rajkumar & Mukhopadhyay,1986)

Score/Grade	Description of disease symptoms
Grade	**Leaf Area Covered**
0	No symptoms (Immune)
1	1–10% (Resistant)
2	11–25% (Moderately resistant)
3	26–50% (Moderately susceptible)
4	51–75% (Susceptible)
5	>75% (Highly susceptible)

2. Per cent disease severity of isabgol was calculated as per formula given by Mc Kinney (1975)

$$\text{Per cent disease severity} = \frac{\text{Sum of all numerical ratings}}{\text{Total no. of plant examined x Highest rating}} \times 100$$

Statistical Analysis

Data were subjected to angular (arc-sine) transformation before analysis. SAS software (version 9.3) was used.

RESULTS

The survey revealed significant geographic variation in the severity of Alternaria blight across 20 locations during the Rabi seasons 2023–24 and 2024–25. The average per cent disease severity of Alternaria blight was ranged from 2.80 to 16.12%. This considerable variation in disease incidence can be attributed to different agro-climatic factors, microclimatic conditions, and variations in agronomic practices, including quality of seed used, sowing date, genetic susceptibility of cultivated varieties, fertilizer application, irrigation regimes, and crop rotation history.

Alternaria blight caused by *Alternaria alternata* was prevalent in all the twenty surveyed locations during the cropping season 2023–24 and 2024-25, indicating the widespread distribution of the pathogen across diverse agro-climatic regions. The per cent disease severity (PDS) varied significantly among locations, ranging from 2.15 to 16.11 per cent, reflecting the influence of local environmental conditions and crop management practices. The highest disease severity was recorded at Jinjinyala, Jodhpur, Rajasthan (16.11%), which was significantly higher than most other locations. However, it was found to be at par with Medicinal and Aromatic Plant Garden, Anand, Gujarat (14.95%) and BRC Farm, Jodhpur (14.52%) followed by Menar F-1, Udaipur (13.47%), Khambolaz village, Anand (12.54%), ARS Farm, Mondor (12.23%), Kalakh, Jobner (12.20%), and Main Experimental Farm, Hisar (12.13%) formed a moderately high disease severity group and were found to be at par with each other, indicating similar epidemiological conditions conducive for disease development.

Similarly, Kunjrao village, Anand (11.65%), Manpuriya F-1, Mandsaur (11.37%), RCA Farm, Udaipur (11.32%), and Ranchhodpura village, Anand (11.23%) recorded moderate disease severity and were statistically at par among themselves, Baori, Nagaur (9.88%), ANDUAT, Ayodhya (9.74%), MAPB at NRC on Seed Spices, Ajmer (8.80%), RVSKVV, Mandsaur (8.30%), and KVK Tabiji Farm, Ajmer (7.98%), which were statistically comparable and constituted a low disease severity group. The minimum disease severity was observed at Haripura, Jaipur (5.56%), Bhainslana, Jobner (4.26%), and Bhookhronki Dhani, Jobner (2.15%), which were significantly different over other locations and differed significantly from high disease severity locations. Jodhpur and Anand regions had higher disease severity, likely due to favorable microclimatic conditions (temperature, humidity, leaf wetness). Jobner locations recorded lower disease intensity, possibly due to less favourable conditions, air circulation, and tolerant varieties.

Table 1: Percent disease severity of Alternaria leaf blight of Isabgol across several agro-climatic regions of India

	Location code	Per cent disease severity(PDS)		
		Alternaria Blight		
S.N.		2023-24	2023-24	Pooled mean
1	ANDUAT (Ayodhya, Uttar Pradesh)	9.74 (18.19)	12.54 (20.74)	11.14 (19.5)
2	RCA Farm (Udaipur, Rajasthan)	11.32 (19.66)	14.01 (21.98)	12.67 (20.85)
3	Menar f-1 (Udaipur, Rajasthan)	13.47 (21.53)	15.02 (22.8)	14.25 (22.18)
4	Kalakh (Jobner, Jaipur, Rajasthan)	12.2 (20.44)	13.5 (21.56)	12.85 (21.01)
5	Haripura, (Jaipur, Rajasthan)	5.56 (13.64)	6.72 (15.02)	6.14 (14.35)
6	Bhainslana (Jobner, Jaipur, Rajasthan)	4.26 (11.91)	4.55 (12.32)	4.41 (12.12)
7	Bhookhronki Dhani (Jobner, Jaipur, Rajasthan)	2.15 (8.43)	3.45 (10.7)	2.8 (9.63)
8	Baori (Nagaur, Rajasthan)	9.88 (18.32)	11.07 (19.43)	10.48 (18.89)
9	BRC Farm, Jodhpur Agriculture University, (Jodhpur, Rajasthan)	14.52 (22.4)	16.42 (23.9)	15.47 (23.16)
10	ARS Farm, Mondor (Jodhpur, Rajasthan)	12.23 (20.47)	12.27 (20.5)	12.25 (20.49)
11	Jinjinyala (Jodhpur, Rajasthan)	16.11 (23.66)	16.12 (23.67)	16.12 (23.67)
12	Medicina & Aromatic Plant Garden, Ashok Nagar (Anand, Gujrat)	14.95 (22.75)	14.48 (22.37)	14.72 (22.56)
13	Ranchhodpura village (Anand, Gujrat)	11.23 (19.58)	14.56 (22.43)	12.9 (21.05)
14	Khambolaz village (Anand, Gujrat)	12.54 (20.74)	11.22 (19.57)	11.88 (20.16)
15	Kunjrao village (Anand, Gujrat)	11.65 (19.96)	10.35 (18.77)	11.0 (19.37)
16	Main Experimantal Farm, Hisar Agriculture University, Hisar, Haryana	12.13 (20.38)	13.67 (21.7)	12.9 (21.05)
17	Manpuriya f-1 (Mandsaur, Madhya Pradesh)	11.37 (19.71)	12.92 (21.07)	12.15 (20.4)
18	RVSKVV (Mandsaur, Madhya Pradesh)	8.3 (16.74)	7.7 (16.11)	8.0 (16.43)
19	Krishi Vigyan Kendra (KVK) at Tabiji Farm , Ajmer, Rajasthan	7.98 (16.41)	6.78 (15.09)	7.38 (15.76)
20	MAPB at NRC on Seed Spices, Ajmer,Rajasthan	8.8 (17.26)	8.34 (16.79)	8.57 (17.02)
C.D at 5%		**1.160**	**1.438**	**1.299**

SEm±	**0.404**	**0.5**	**0.452**
C.V. %	**6.412**	**7.983**	**7.198**

**Figures in the parenthesis are Angular Transformed values*

Plate 1: Survey of Alternaria blight severity of isabgol across different agro-climatic regions

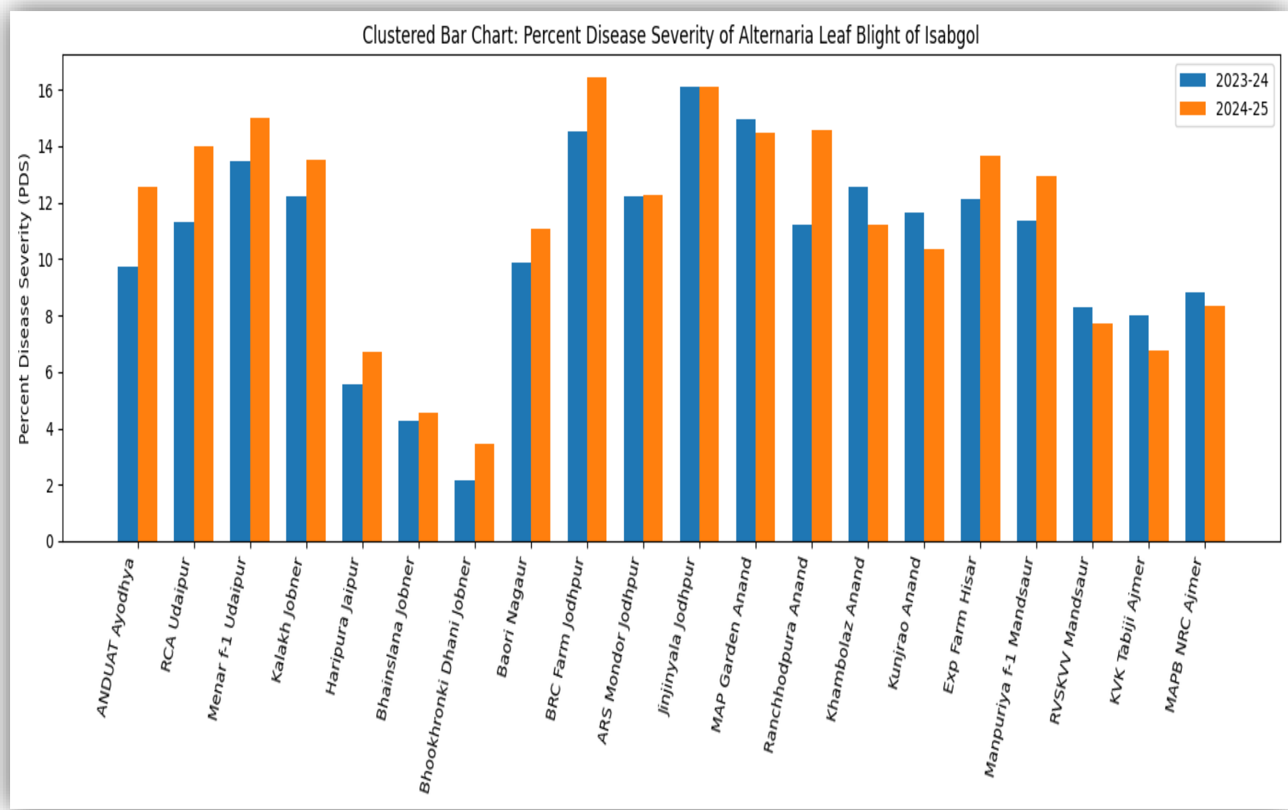

Figure 1: Disease severity of Alternaria leaf spot disease of isabgol across different location

Discussion

This multi-location survey provides baseline epidemiological data on Alternaria blight of isabgol. The observed variation (2.15–16.11%) highlights the role of geographic location, environment, host susceptibility, and management practices. The disease was observed at all the surveyed locations, confirming the widespread distribution and endemic nature of *A. alternata*. However, significant variation in disease intensity among locations highlights the role of local environmental conditions, agronomic practices, and inoculum pressure in disease expression. Similar location-specific variability in Alternaria blight has also been reported earlier under Indian conditions (Bajaya *et al*., 2021).

The highest disease severity recorded at Jinjinyala, Jodhpur (16.11%) may be attributed to favourable microclimatic conditions such as optimal temperature, relatively higher humidity during critical crop growth stages, and prolonged leaf wetness period, which are known to enhance sporulation and infection by Alternaria spp. Locations including Medicinal and Aromatic Plant Garden, Anand and BRC Farm, Jodhpur, which were statistically at par with Jinjinyala, further suggest that similar epidemiological conditions prevailed across these sites, leading to enhanced disease development. Moderately high disease severity recorded at locations such as Menar F-1, Udaipur; Khambolaz village, Anand; ARS Farm, Mondor; Kalakh, Jobner; and Main Experimental Farm, Hisar indicates intermediate but conducive environmental conditions for disease establishment. Differences in sowing time, varietal susceptibility, nutrient management, and irrigation practices may have contributed to the observed variation among these locations, as reported earlier by Meynard *et al.* (2003) and Castro (2001).

Lower disease severity at locations such as Baori, Nagaur; ANDUAT, Ayodhya; MAPB at NRC on Seed Spices, Ajmer; RVSKVV, Mandsaur; and KVK Tabiji Farm, Ajmer may be attributed to comparatively less favourable climatic conditions, reduced humidity, better air circulation, and effective crop management practices, which limit pathogen multiplication and disease spread. The minimum disease severity recorded at Haripura, Jaipur; Bhainslana, Jobner; and Bhookhronki Dhani, Jobner suggests that local microclimatic conditions and possibly the use of better-quality seed and tolerant cultivars played a crucial role in suppressing disease development.

Environmental parameters such as temperature, relative humidity, rainfall, and dew formation are known to significantly influence the occurrence and severity of Alternaria blight (Ganie *et al*., 2015; Yadav *et al*., 2021; Dhaka *et al*., 2022). The comparatively higher disease severity observed in Jodhpur and Anand regions may be associated with climatic conditions favourable for pathogen survival and secondary spread, whereas Jobner locations consistently exhibited lower disease intensity, indicating relatively unfavourable conditions for disease progression.

In conclusion, the present survey clearly demonstrates that Alternaria blight severity is highly location-specific and governed by the interaction of environmental factors, host susceptibility, and agronomic practices. The findings provide valuable baseline information for understanding the regional distribution of Alternaria blight and will be useful in formulating location-specific integrated disease management strategies for sustainable cultivation of isabgol under diverse agro-climatic conditions.

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