International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
ISSN: 2664-7133
Received: 12-09-2026, Accepted: 12-10-2026, Published: 27-10-2026
Volume 8, Issue 4, 2026, Page No. 145-149

Screening for powdery mildew disease resistance in F_5 families of the cross JNA1 and Byadgi Dabbi in chilli (*Capsicum annuum* L.)

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DOI: https://doi.org/10.66856/ijees.2026.8.4.8111

Abstract
The present study was undertaken to evaluate advanced breeding lines of chilli (*Capsicum annuum* L.) for their reaction to powdery mildew caused by *Leveillula taurica* under natural epiphytotic conditions during Kharif 2025–26. Forty-five advanced breeding lines along with four checks were evaluated based on mean per cent disease index (PDI), area under disease progress curve (AUDPC), disease grade and disease reaction. Considerable variation was observed among the genotypes for powdery mildew response. The mean PDI ranged from 3.7 per cent in Arka Harita to 65.0 per cent in ABL 4, while AUDPC ranged from 50.0 in Arka Harita to 917.8 in ABL 4. Among the advanced breeding lines, ABL 14 recorded the lowest mean PDI of 28.3 per cent and an AUDPC of 391.1, indicating comparatively lower disease development. Based on the 0–9 disease grading scale, Arka Harita exhibited a resistant (R) reaction, Arka Saphal showed a moderately resistant (MR) reaction, and ABL 14 was classified as moderately susceptible (MS). The remaining advanced breeding lines were categorized as highly susceptible (HS), including the checks BVC 42 and Byadgi Dabbi. No genotype exhibited immune or highly resistant reaction. The comparatively lower disease severity in ABL 14 indicates its potential as a useful source for further evaluation and breeding for improved powdery mildew response. The observed variation among the breeding lines provides scope for selection and utilization of promising material in chilli improvement programmes aimed at developing genotypes with enhanced tolerance to powdery mildew.

Keywords: Chilli, Screening, powdery mildew

Introduction
Chilli (*Capsicum annuum* L.), commonly known as hot pepper, is an important annual herbaceous crop belonging to the family Solanaceae. It is indigenous to Tropical America and has a diploid chromosome number of 2n = 24. The genus *Capsicum* comprises about 30 species, of which five species, namely C. annuum, C. frutescens, C. chinense, C. pubescens and C. baccatum, are cultivated. Among these, C. annuum is the most widely cultivated and economically important species in India (Saxena *et al*., 2016; Chhapekar *et al*., 2016) [2, 10]. Chilli is cultivated for both green and dry fruit purposes and is valued for its pungency, colour, flavour and aroma. Capsaicin is mainly responsible for pungency, whereas carotenoids such as capsanthin and capsorubin impart the characteristic red colour to mature fruits. Chilli is also a rich source of vitamins, particularly A, C and E, and is widely used in chilli powder, oleoresin, natural food colourants, culinary preparations and medicinal products (Herath *et al*., 2021) [6].

India is one of the leading producers, consumers and exporters of chilli, with Andhra Pradesh being a major producing state and Karnataka contributing significantly to production. Among the important commercial types, Byadagi Dabbi is valued for its high colour intensity, low pungency, flavour and aroma and is used for both green and dry chilli purposes. Its desirable quality characteristics make it important for processing and value-added products. However, chilli production is affected by several biotic stresses, among which powdery mildew is an important foliar disease.

Powdery mildew caused by Leveillula taurica is an important foliar disease of chilli that can reduce plant growth and fruit production. Screening breeding material under natural disease pressure using disease grade, Mean Percent Disease Index (PDI) and Area Under Disease Progress Curve (AUDPC) helps identify genotypes with reduced disease severity. Such promising genotypes can serve as useful sources for improving powdery mildew resistance in chilli breeding programmes (Tiwari *et al*., 2024) [14].

Therefore, the present study was undertaken to evaluate advanced breeding lines of chilli for their reaction to powdery mildew under natural epiphytotic conditions and identify promising genotypes for further breeding.

Material and Methods
The present investigation was conducted during the late Kharif season of 2025–26 at the Postgraduate Research Block, Main Agricultural Research Station (MARS), University of Agricultural Sciences, Raichur, Karnataka, in red sandy loam soil. The experimental site is situated in the North-Eastern Dry Zone (Zone-II) of Karnataka at 16°12′ N latitude and 77°21′ E longitude, with an elevation of 389 m above mean sea level. The region receives an average annual rainfall of about 879 mm, with mean maximum temperature above 34°C and relative humidity ranging from 42 to 75 per cent during the monsoon months. Weekly

meteorological data during the crop growth period were obtained from the Meteorological Observatory, MARS, UAS, Raichur.

The experimental material consisted of 45 F_5 families derived from the cross JNA1 × Byadgi Dabbi, along with four check varieties. The experiment was laid out in an Augmented Block Design with five blocks, each containing nine F_5 lines and four checks. The check entries were randomized to maintain a minimum of 12 degrees of freedom, and observations were recorded on five plants from each F_5 line. Seeds were sown in protrays under glasshouse conditions and 45-day-old seedlings were transplanted to the field at a spacing of 60 × 45 cm. Recommended agronomic practices were followed throughout the crop period.

The 45 advanced F_5 breeding lines were evaluated for their response to powdery mildew caused by Leveillula taurica under natural epiphytotic conditions during late Kharif 2025–26. Disease severity was recorded at weekly intervals from the first appearance of symptoms up to fruit maturity on five plants per genotype using the 0–9 disease rating scale of Mayee and Datar (1986) [8], where ratings of 0, 1, 3, 5, 7 and 9 represented 0, ≤1, 1–10, 11–25, 26–50 and >50 per cent leaf area affected, respectively. The disease scores were converted into Percent Disease Index (PDI) following Wheeler (1969) [16], and the Area Under Disease Progress Curve (AUDPC) was calculated using the trapezoidal method of Shaner and Finney (1977) [11] to quantify cumulative disease development. Based on PDI, genotypes were classified as immune, highly resistant, resistant, moderately resistant, moderately susceptible and highly susceptible following Khare and Lakpale (1997) [7]. Mean PDI and AUDPC were used together to characterize the disease response of the F_5 lines, with lower values indicating comparatively lower disease severity and slower disease progression.

Results and Discussion

The F_5 chilli lines exhibited considerable variation in response to powdery mildew (Leveillula taurica) under natural epiphytotic conditions during late Kharif 2025–26. Disease symptoms initially appeared as pale green to yellow chlorotic lesions on the upper surface of older leaves, followed by characteristic white powdery growth on the corresponding lower surface. With disease progression, infected leaves developed chlorosis, curling, premature senescence and defoliation, resulting in reduced plant vigour. The differential disease expression among the F_5 lines indicated substantial variability for powdery mildew response, which was further quantified using Mean Percent Disease Index (PDI) and Area Under Disease Progress Curve (AUDPC).

A wide range of variation was observed for both Mean PDI and AUDPC, with values ranging from 28.3 to 65.0 and 391.1 to 917.8, respectively. The resistant checks, Arka Harita and Arka Saphal, recorded markedly lower disease severity, with Mean PDI and AUDPC values of 3.7 and 50.0, and 14.1 and 194.4, respectively. In contrast, the susceptible checks Byadagi Dabbi and BVC 42 recorded high Mean PDI values of 64.1 and 65.0 and AUDPC values of 915.6 and 906.7, respectively, confirming adequate disease pressure and the reliability of the screening conditions. Among the F_5 lines, ABL 14 recorded the lowest Mean PDI (28.3) and AUDPC (391.1), indicating comparatively slower disease development. Other lines such as ABL 28, ABL 19, ABL 22, ABL 23, ABL 41 and ABL 42 also showed relatively lower disease progression than most of the remaining segregants. Conversely, ABL 4 recorded the highest Mean PDI (65.0) and AUDPC (917.8), followed by ABL 9, ABL 11, ABL 3, ABL 12, ABL 2 and ABL 18, indicating greater susceptibility. The close correspondence between Mean PDI and AUDPC demonstrated that genotypes with lower disease severity also exhibited lower cumulative disease development. Similar relationships between disease severity and AUDPC have been reported in chilli by Wankhade and Mohrir (2015) [15], Hareesh *et al*. (2016) [5], Tembhurne *et al*. (2021) [13], Tiwari *et al*. (2024) [14] and Saha *et al*. (2025) [9]. Disease-reaction classification further confirmed substantial variability among the F_5 families. Arka Harita and Arka Saphal expressed resistant reactions, whereas Byadagi Dabbi and BVC 42 were highly susceptible, providing effective contrasting standards for field screening. Among the 45 F_5 lines, ABL 14 was classified as moderately susceptible (MS), although it recorded the lowest Mean PDI (28.3) and AUDPC (391.1) among the breeding lines. Its comparatively lower disease severity and slower disease progression distinguished it from the remaining segregants, but the disease level was insufficient to classify it as moderately resistant. The majority of the F_5 lines were grouped under the moderately susceptible category, while a limited number exhibited susceptible to highly susceptible reactions.

The predominance of moderately susceptible genotypes indicates considerable segregating variation for powdery mildew response within the F_5 population and provides scope for further selection. Similar variation in powdery mildew response among *Capsicum* germplasm has been reported by Deshpande *et al*. (1984) [4], De Souza and Cafe-Filho (2003) [3], Sharmila *et al*. (2006) [12], Asthaputre (2006) [1], Hareesh *et al*. (2016) [5] and Tiwari *et al*. (2024) [14]. The identification of ABL 14 as a moderately susceptible genotype with comparatively lower disease severity is relevant for further selection within the segregating population. Although it did not express a resistant reaction, its relatively lower PDI and AUDPC compared with other F_5 lines indicate slower disease development under the prevailing field conditions. Therefore, ABL 14 may be considered a comparatively less susceptible breeding line and can be further evaluated across environments and generations to determine the stability of its response. The contrasting performance of the resistant checks and susceptible genotypes also confirms the usefulness of the screening population for identifying variation in powdery mildew response.

Table 1: Mean PDI and AUDPC values of advanced breeding lines against powdery mildew disease caused by Leveillula taurica in Chilli

SL. NO.	Lines	Mean PDI	AUDPC	SL. NO.	Lines	Mean PDI	AUDPC	SL. NO.	Lines	Mean PDI	AUDPC
01	ARKA HARITA	3.7	50.0	18	ABL 14	28.3	391.1	35	ABL31	62.7	882.2
02	ARKA SAPHAL	14.1	194.4	19	ABL 15	60.9	857.8	36	ABL32	60.6	853.3
03	BVC 42	65.0	906.7	20	ABL 16	60.6	853.3	37	ABL33	62.4	877.8
04	B DABBI	64.1	915.6	21	ABL 17	61.2	860.0	38	ABL34	62.1	873.3
05	ABL1	62.1	875.6	22	ABL 18	63.0	886.7	39	ABL35	60.6	851.1
06	ABL2	63.0	888.9	23	ABL 19	59.4	835.6	40	ABL36	60.9	857.8
07	ABL 3	63.6	895.6	24	ABL 20	62.4	877.8	41	ABL37	61.5	866.7
08	ABL 4	65.0	917.8	25	ABL 21	60.9	857.8	42	ABL38	60.6	851.1
09	ABL 5	61.8	871.1	26	ABL 22	59.4	833.3	43	ABL39	61.5	866.7
10	ABL 6	60.6	853.3	27	ABL 23	59.7	840.0	44	ABL40	62.1	873.3
11	ABL 7	62.4	877.8	28	ABL 24	62.1	875.6	45	ABL41	60.0	844.4
12	ABL 8	61.8	871.1	29	ABL 25	61.5	866.7	46	ABL42	60.0	844.4
13	ABL 9	63.9	900.0	30	ABL 26	64.7	911.1	47	ABL43	62.7	882.2
14	ABL 10	62.4	880.0	31	ABL 27	61.8	871.1	48	ABL44	62.4	880.0
15	ABL 11	63.9	902.2	32	ABL 28	58.2	817.8	49	ABL45	61.5	866.7
16	ABL 12	63.6	895.6	33	ABL 29	64.1	902.2				
17	ABL 13	62.4	877.8	34	ABL 30	61.2	862.2				

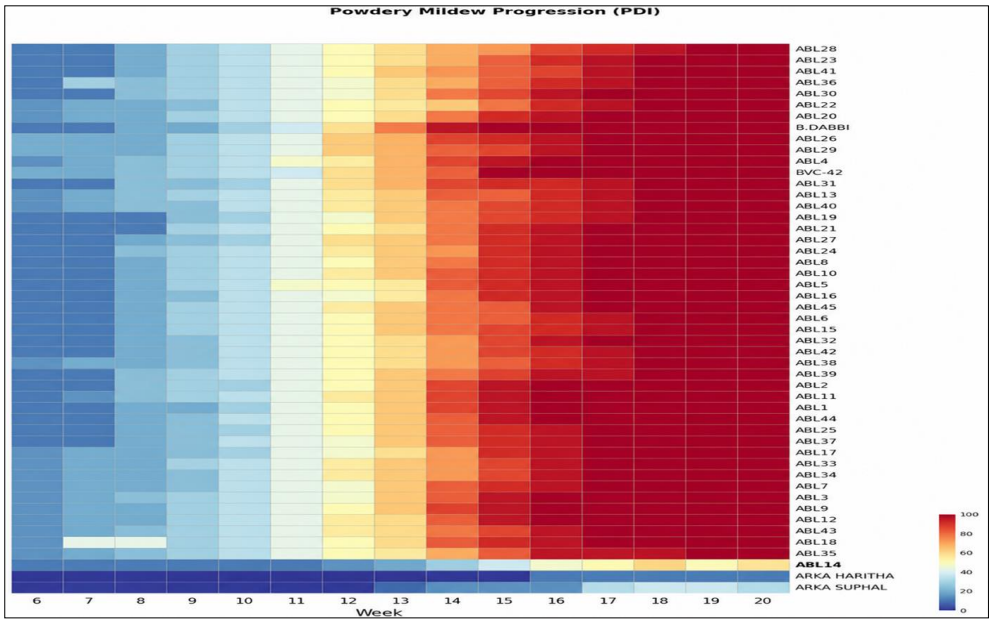


Fig 1: Percent Disease Index (PDI) for chilli powdery mildew during late *Kharif* – 2025-26

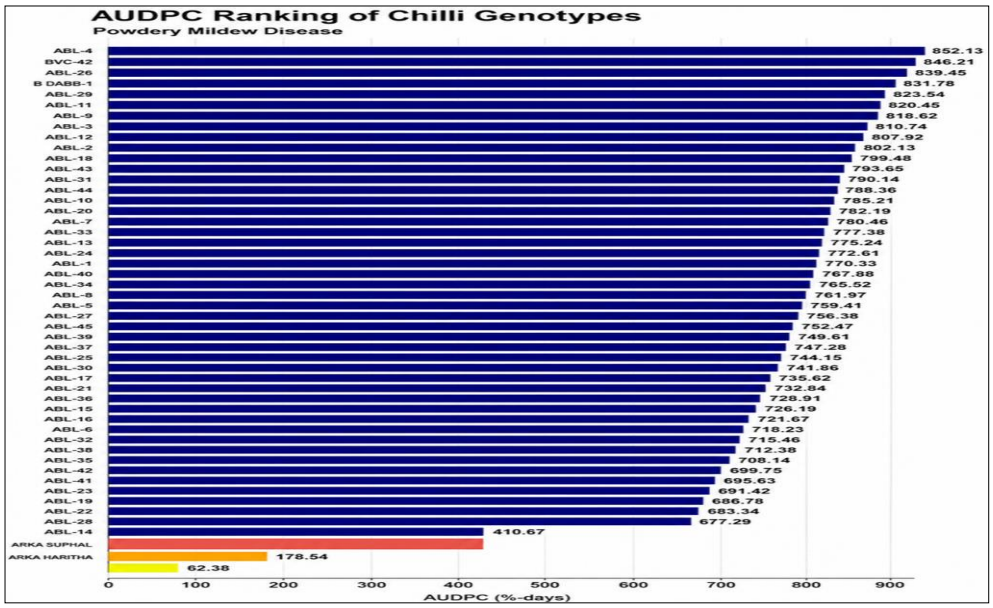


Fig 2: Area Under Disease Progress Curve (AUDPC) for chilli powdery mildew during late *Kharif* – 2025-26

Table 2: Disease grade and reaction of advanced breeding lines against powdery mildew disease in advanced breeding lines of Chilli during *Kharif* 2025-26

Sl. No.	Lines	Disease Grade	Disease Reaction	Sl. No.	Lines	Disease Grade	Disease Reaction	Sl. No.	Lines	Disease Grade	Disease Reaction
01	ARKA HARITA	3	R	18	ABL 14	7	MS	35	ABL31	9	HS
02	ARKA SAPHAL	5	MR	19	ABL 15	9	HS	36	ABL32	9	HS
03	BVC42	9	HS	20	ABL 16	9	HS	37	ABL33	9	HS
04	B DABBI	9	HS	21	ABL 17	9	HS	38	ABL34	9	HS
05	ABL1	9	HS	22	ABL 18	9	HS	39	ABL35	9	HS
06	ABL2	9	HS	23	ABL 19	9	HS	40	ABL36	9	HS
07	ABL 3	9	HS	24	ABL 20	9	HS	41	ABL37	9	HS
08	ABL 4	9	HS	25	ABL 21	9	HS	42	ABL38	9	HS
09	ABL 5	9	HS	26	ABL 22	9	HS	43	ABL39	9	HS
10	ABL 6	9	HS	27	ABL 23	9	HS	44	ABL40	9	HS
11	ABL 7	9	HS	28	ABL 24	9	HS	45	ABL41	9	HS
12	ABL 8	9	HS	29	ABL 25	9	HS	46	ABL42	9	HS
13	ABL 9	9	HS	30	ABL 26	9	HS	47	ABL43	9	HS
14	ABL 10	9	HS	31	ABL 27	9	HS	48	ABL44	9	HS
15	ABL 11	9	HS	32	ABL 28	9	HS	49	ABL45	9	HS
16	ABL 12	9	HS	33	ABL 29	9	HS				
17	ABL 13	9	HS	34	ABL 30	9	HS				

Conclusion

The screening of 45 F_5 chilli families derived from the cross JNA1 × Byadgi Dabbi under natural epiphytotic conditions revealed considerable variability for powdery mildew response, as indicated by the variation in Mean PDI and AUDPC. The resistant checks Arka Harita and Arka Saphal recorded lower disease severity, while Byadagi Dabbi and BVC-42 showed higher severity, confirming adequate disease pressure and reliable screening conditions. Among the F_5 families, ABL 14 recorded the lowest Mean PDI (28.3) and AUDPC (391.1), although it was classified as moderately susceptible. Other comparatively less affected families included ABL 28, ABL 19, ABL 22, ABL 23, ABL 41 and ABL 42, while most families exhibited moderately susceptible to highly susceptible reactions. The close correspondence between Mean PDI and AUDPC indicated similar trends in disease severity and cumulative disease development. Overall, the observed variability provides scope for further evaluation and selection of comparatively less affected families, particularly ABL 14, for subsequent breeding programmes aimed at improving powdery mildew response in chilli.

Acknowledgement

We express our sincere gratitude to the Main Agricultural Research Station (MARS), Raichur, and the Post Graduate Studies (PGS), College of Agriculture, Raichur, for providing the experimental plot at the Postgraduate Research Block and extending valuable support in carrying out the intercultural operations throughout the experiment.

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