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RESEARCH ARTICLE

Evaluation of durable host resistance to turcicum leaf blight in maize across two-season field trials

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Abstract

Maize (*Zea mays* L.) is a key global cereal crop, but its productivity is often constrained by turcicum leaf blight (TLB), caused by *Exserohilum turcicum*. To identify sources of genetic resistance, 88 maize inbred lines were evaluated under artificial epiphytotic conditions during *Kharif* 2024 and 2025 at ZARS, V.C. Farm, Mandya. Inoculum was mass-multiplied on sorghum grains and applied twice (30 and 40 days after sowing), followed by a light water spray to ensure effective infection. Disease severity was recorded using a 1-9 modified disease rating scale and inbred lines were categorised based on per cent disease index (PDI), lesion length and days to symptom appearance. Nine inbreds (CML 11, CML 34, CML 50, CML 59, CML 93, CML 94, CML 173, CML 191 and the resistant check SKV-50) consistently exhibited resistant reactions, showing low PDI (2.94-27.05 %) and delayed symptom onset (12-17.5 days). Sixty-two inbreds were moderately resistant (PDI 31-50 %), while sixteen were moderately susceptible (PDI 51-70 %). In contrast, CML 166, CML 176 and the susceptible check CM-202 were highly susceptible, exhibiting PDI ≥ 70 %, rapid symptom appearance (4.5-6 days) and extensive lesion expansion (>30 cm^2). Although season-to-season variations in disease pressure were recorded, inbred rankings remained stable. The resistant lines identified provide valuable genetic resources for breeding stable TLB resistance, while the susceptible lines offer reliable checks for understanding host-pathogen interactions.

Keywords: *Exserohilum turcicum*; inbreds; resistant; susceptible

Introduction

Maize, often referred to as the "queen of cereals," holds a pivotal role in global agriculture due to its wide adaptability and versatile uses (1). Among cereal crops, maize holds the top position in global production, followed by wheat and rice, with an annual output exceeding 1 billion tonnes (2). It is recognised as a key crop for fulfilling the growing demand for food and energy worldwide. Since the domestication of maize from its wild ancestors, breeding programme have primarily focused on developing high-yielding cultivars to enhance productivity. In India, maize plays a vital role not only in human consumption but also as a key component of the livestock and poultry feed industry, which utilises more than half of the total domestic production. Additionally, maize is increasingly being used as a feedstock for bioethanol production, supporting the country's renewable energy initiatives (3). These trends highlight the huge demands for genetic diversity in maize breeding to cope with the challenges of the 21st century, including climate change, food security and sustainable energy.

Exserohilum turcicum, the causal agent of TLB, is a hemibiotrophic fungus that infects maize foliage and can cause significant losses when epidemics occur early in the growing season. The pathogen produces conidia that germinate under high humidity (≥ 90 %) and moderate temperatures (1827 °C), allowing rapid penetration through stomata and subsequent colonisation of mesophyll tissues. Initial symptoms appear as small, water-soaked flecks that elongate into characteristic greyish-brown, cigar-shaped lesions measuring 215 cm in length. Under favourable environmental conditions, lesions coalesce, resulting in extensive leaf blight, premature senescence and reduced photosynthetic activity, ultimately lowering grain yield. The pathogen survives on infected crop residues, enabling early-season inoculum buildup

and shows considerable variability, with multiple physiological races reported globally (4). This biological complexity and symptom progression highlight the need for identifying stable sources of resistance for effective and sustainable TLB management. Genetic resistance in crop plants against pathogens is considered a safe, cost-effective and environmentally sustainable approach to disease management. Unlike chemical control, which requires repeated applications, increases production costs and may leave harmful residues or lead to resistance development-genetic resistance provides long-term protection without adverse environmental effects. It reduces dependence on pesticides and supports eco-friendly, sustainable crop production. Both genetic diversity and pathogen virulence play crucial roles in determining host resistance and in developing effective disease control strategies. The fungus *E. turcicum* exhibits considerable variation in its cultural, pathogenic and genetic characteristics, with the extent of variability differing among isolates and notably, race 4 of *E. turcicum* is recognised for its higher virulence and ability to overcome specific host resistance genes. A major constraint in enhancing maize productivity is the widespread cultivation of traditional landraces, which are highly vulnerable to several biotic stresses, especially TLB. This disease can cause substantial yield losses, particularly when infection occurs before the silking stage (5). Due to shifts in cultivation practices and climatic conditions, coupled with the widespread cultivation of susceptible maize hybrids and the considerable pathogenic variability of *E. turcicum*, the incidence and severity of TLB have shown a rising trend globally. This escalating threat underscores the urgent need to develop and deploy maize hybrids with enhanced resistance to TLB (6, 7).

Adding to the challenge, the genetic profiles of many commercial hybrids, particularly those released by private breeding companies, are often not publicly disclosed. This lack of transparency hampers a comprehensive understanding of plant resistance mechanisms and the development of targeted management strategies. Therefore, the present study aims to identify maize inbreds exhibiting strong and stable resistance to TLB under controlled field conditions, thereby providing a scientific basis and technical guidance for effective disease management and the strategic distribution of resistant hybrids in maize production systems.

Materials and Methods

Collection of diseased samples and isolation of the pathogen

Maize leaves exhibiting characteristic cigar-shaped lesions, caused by *E. turcicum*, were collected from the experimental plots of the All India Coordinated Maize Improvement Project, V.C. Farm, Mandya, for pathogen isolation during 2024 and 2025. The fungus was obtained using a standard tissue isolation method (8). A total of 88 genotypes were screened against TLB. Small sections of the diseased leaf tissue, including both the necrotic and adjacent healthy areas, were surface sterilised with a 2 % sodium hypochlorite solution for 1 min and subsequently rinsed 3 times with sterile distilled water to eliminate any residual disinfectant. The sterilised leaf segments were aseptically transferred onto Potato Dextrose Agar (PDA) plates and incubated at 27 ± 1 °C under standard laboratory conditions. Visible fungal colonies appeared within 48-72 hr of incubation. The emerging cultures from these tissue pieces were subsequently transferred to PDA slants and kept at room temperature for about 15 days, during which profuse sporulation occurred. To ensure genetic uniformity, the isolate was further purified through the hyphal-tip isolation method.

Mass multiplication

For large-scale multiplication of *E. turcicum*, sterilised sorghum grains were used as the substrate (9). Approximately 40-45 g of grains (forming a layer about one inch thickness) were placed in a 500 mL conical flask, soaked in water for 34 hr and the excess moisture was drained off. The flasks were then autoclaved at a pressure of 15 psi at 121 °C to ensure complete sterilisation. Under aseptic conditions, the sterilised grains were inoculated with the fungal culture and incubated at 27 ± 1 °C under a 12 hr light/12 hr dark photoperiod, as light-dark conditions are known to influence fungal growth and sporulation. To promote uniform colonisation, the flasks were gently shaken every 2-3 days. After an incubation period of about two weeks, the colonised sorghum grains were ready to be used as inoculum. These grains were spread on clean paper sheets in the shade at room temperature and allowed to dry. Once dried, they were ground into a fine powder using a mixer -grinder. For field inoculation, artificial inoculation was carried out twice, at 30 and 40 days after sowing, to ensure effective disease establishment.

The experiment was laid out as a randomised complete block design (RCBD) with two replications conducted over two *Kharif* seasons (2024 and 2025). Each plot measured 5.0 m × 30.0 m, having 60 cm row to row spacing and 20 cm plant to plant spacing. Eighty-eight maize hybrids were evaluated under artificially inoculated conditions. Along with the test entries, a resistant check (SKV-50) and a susceptible check (CM-202) were included and all treatments were arranged in two replications, which, although minimal, were used due to logistical and resource constraints and are acknowledged as a limitation of the study. The crop was raised following standard agronomic practices, except for the omission of disease control measures. The *E. turcicum* inoculum was multiplied on sorghum grains and applied to the leaf whorls of plants at 30 and 40 days after sowing at a rate of 2 g per plant during evening hr. To maintain sufficient humidity and promote infection, a light misting of water was done immediately after inoculation.

The observations on the disease severity of TLB were recorded based on 1-9 modified disease rating scale proposed by the Indian Institute of Maize Research, Ludhiana (10) as given below in Table 1.

The % disease index was calculated following the formulae below mentioned

$$\% \text{ Disease index/ severity } (\%) = \frac{\text{Sum of all disease ratings}}{\text{Total no. of plants observed} \times \text{maximum disease}} \times 100$$

Statistical analysis

The whole experimental setup was replicated thrice with an RCBD for better comparison. Statistical analysis was done by following the procedures given by Panse & Sukhatme (11). Original data in per cent were converted to angular transformed values before analysis. The graphs and analysis were done using SPSS and R Studio software.

Table 1. Modified disease rating scale for TLB (1–9)

Rating scale	Degree of infection	Disease reaction
1	Nil to very slight infection (≤ 10 %)	Resistant (Score: ≤ 3.0)
2	Slight infection, a few lesions scattered on 2 lower leaves (10.1-20 %)	
3	Light infection, moderate number of lesions scattered on 4 lower leaves (20.1-30 %)	
4	Light infection, moderate number of lesions scattered on lower leaves, a few lesions scattered on middle leaves below the cob (30.1-40 %)	Moderately resistant (Score: 3.1-5.0)
5	Moderate infection, an abundant number of lesions scattered on lower leaves, a moderate number of lesions scattered on middle leaves below the cob (40.1-50 %)	
6	Heavy infection, an abundant number of lesions scattered on lower leaves, moderate infection on middle leaves and a few lesions on 2 leaves above the cob (50.1-60 %)	Moderately susceptible (Score: 5.1-7.0)
7	Heavy infection, an abundant number of lesions scattered on lower and middle leaves and a moderate number of lesions on 2 - 4 leaves above the cob (60.1-70 %)	
8	Very heavy infection, lesions are abundant, scattered on lower and middle leaves and spreading up to the flag leaf (70.1-80 %)	Susceptible (Score: >7.0)
9	Very heavy infection, lesions are abundant, scattered on almost all the leaves, the plant prematurely dried and killed (>80 %)	

Results and Discussion

The findings of the experiment demonstrated distinct differential responses among the evaluated maize germplasm to the TLB pathogen under artificially inoculated field conditions. Screening of 88 maize inbreds, along with the susceptible check CM-202 and the resistant check SKV-50, during the *Kharif* seasons of 2024 and 2025, revealed a broad range of disease reactions (Table 2, 3, Fig. 1, 2). Significant variation was observed in terms of PDI, days for onset of symptom expression and lesion length, highlighting the presence of diverse sources of resistance within the tested germplasm.

The pooled analysis across the 2 seasons revealed that nine inbreds, *viz*., CML 11, CML 34, CML 50, CML 59, CML 93, CML 94, CML 173, CML 191 and SKV-50, displayed resistant reactions with PDI values ranging from 2.94 to 27.05 and relatively short lesion lengths (2.91-12.17 cm^2). These inbreds also exhibited a delayed onset of symptoms (12-17.5 days), reflecting stable resistance expression. A total of 53 inbreds were identified as moderately resistant, showing pooled PDI values ranging from 31 to 50 %. Among these, entries such as CML 3, CML 8, CML 15, CML 19 and CML 23 displayed limited lesion expansion (15-22 cm^2) and slower disease progression compared to susceptible lines. These inbreds serve as valuable sources of partial resistance and can be effectively used in breeding programmes to develop durable resistance to TLB. In contrast, 25 inbreds showed moderately susceptible reactions, with PDI values between 51 and 70 % and lesion sizes larger than 25 cm^2. Entries including CML 12, CML 17, CML 37, CML 44 and CML 53 supported faster disease progression and earlier symptom appearance (6-8 days). Fully susceptible reactions were observed in CML 166, CML 176 and the susceptible check CM-202, which recorded maximum PDI values (≥ 70 %), rapid symptom onset (4.5-6 days) and extensive lesion expansion (> 30 cm^2). The consistent performance of CM-202 as a susceptible check across seasons confirmed the reliability of the screening conditions (Table 2, 3, Fig. 2, 3).

Seasonal weather conditions differed considerably between *Kharif* 2024 and 2025 (Table 4). Higher total rainfall, more rainy days and greater relative humidity in 2024 created a more conducive microclimate for *E. turcicum* infection and lesion expansion, resulting in comparatively higher disease pressure. In contrast, reduced rainfall and lower humidity in 2025 likely limited pathogen sporulation and secondary spread, leading to slightly lower PDI values. The weather data thus support and justify the seasonal differences in disease intensity observed in the present study. When data were compared across the two *Kharif* seasons (2024 and 2025), noticeable year-to-year variations in disease intensity were recorded. Such variations are typical in field screening trials, as pathogen growth and host-pathogen interactions are greatly affected by the surrounding environmental conditions. Noticeable differences in PDI values were observed between seasons, with slightly higher disease pressure in 2024 than in 2025. The reduced rainfall during the flowering stage in 2025 likely played a role in limiting disease development that year. However, environmental conditions across both testing seasons were generally favourable for the occurrence of leaf blight. Previous research on leaf blight has demonstrated that the dropper inoculation method is effective and helps reduce the risk of disease escape during evaluation (12). In this study, the inoculation approach proved to be both practical and dependable. Clear distinctions were observed between resistant and susceptible inbreds, with later maturing inbreds showing a moderate increase in infected leaf area at the flowering stage. In some instances, individuals inbreds with comparatively lower susceptibility were identified. Selecting these less susceptible inbreds could facilitate the accumulation of minor resistance genes, thereby enhancing the overall level of field resistance (13-15). However, the ranking of resistant and susceptible entries remained consistent across years, underscoring the stability of resistance in identified inbreds.

The present results are in agreement with the findings of a previous study (16) evaluating 37 maize inbred lines under artificially inoculated field conditions. The study reported that inbreds CI-4, CM-104 and NAI-147 exhibited resistant reactions to *E. turcicum*, while CM-111, CM-501, CM-121, KDMI-12 and CM-118 showed intermediate responses. Conversely, CM-202, CM-115, CM-117, CM-128, CM-600 and KDMI-10 were identified as highly susceptible. In the current investigation, most of the evaluated entries displayed moderate resistance, aligning with the observations of a previous study (17), which screened 239 maize hybrids for TLB resistance and found 92 genotypes to be moderately resistant. Furthermore, this study identified new potential sources of resistance (CML 11, CML 93 and CML 191) under artificial epiphytotic conditions. These resistant inbreds hold great

Table 2. Field screening of maize inbreds against TLB during 2024 and 2025

Sl.No.	Inbreds	Per cent Disease Index (PDI)			Rating scale	Days taken for the appearance of symptoms			Lesion length (cm^2)		
		2024	2025	Pooled		2024	2025	Pooled	2024	2025	Pooled
1	CML 3	33.33	28.92	31.13	MR	10.50	10.00	10.25	20.40	18.25	19.33
2	CML 8	36.54	31.21	33.88	MR	10.00	10.50	10.25	18.45	18.61	18.53
3	CML 10	34.33	30.45	32.39	MR	9.50	10.50	10.00	17.56	18.65	18.11
4	CML 11	3.13	2.75	2.94	R	16.00	17.50	16.75	3.12	2.70	2.91
5	CML 12	52.21	51.70	51.96	MS	7.00	8.50	7.75	26.48	23.31	24.90
6	CML 13	51.98	59.48	55.73	MS	7.00	10.50	8.75	24.90	21.87	23.39
7	CML 15	37.33	35.02	36.18	MR	10.50	11.50	11.00	16.20	14.35	15.28
8	CML 16	41.58	37.20	39.39	MR	10.00	10.50	10.25	18.54	17.37	17.96
9	CML 17	57.81	50.22	54.02	MS	6.00	7.50	6.75	28.50	30.72	29.61
10	CML 19	31.54	31.41	31.48	MR	11.50	12.50	12.00	15.32	17.12	16.22
11	CML 20	31.71	31.58	31.65	MR	11.50	14.00	12.75	14.40	11.39	12.90
12	CML 21	61.20	57.21	59.21	MS	7.50	8.00	7.75	32.50	30.39	31.45
13	CML 23	31.05	35.65	33.35	MR	9.50	10.50	10.00	18.54	16.25	17.40
14	CML 24	53.81	51.64	52.73	MS	6.50	8.50	7.50	28.70	26.64	27.67
15	CML 29	36.84	32.87	34.86	MR	10.50	11.50	11.00	25.10	23.97	24.54
16	CML 30	29.25	33.69	31.47	MR	10.00	10.50	10.25	19.32	17.31	18.32
17	CML 31	39.21	35.85	37.53	MR	10.00	11.50	10.75	20.45	18.42	19.44
18	CML 32	34.56	30.33	32.45	MR	11.00	11.50	11.25	20.54	17.36	18.95
19	CML 34	5.17	4.98	5.08	R	15.50	16.00	16.50	4.40	3.46	3.93
20	CML 35	33.67	33.00	33.34	MR	11.00	13.00	12.00	16.56	14.53	15.55
21	CML 36	40.61	35.42	38.02	MR	9.50	10.50	10.00	19.00	19.00	19.00
22	CML 37	53.21	50.98	52.10	MS	7.50	8.50	8.00	27.78	24.66	26.22
23	CML 41	33.57	32.01	32.79	MR	11.00	12.50	11.75	23.47	20.74	22.11
24	CML 44	52.84	53.21	53.03	MS	6.50	8.50	7.50	28.52	24.60	26.56
25	CML 48	54.01	51.33	52.67	MS	6.50	7.50	7.00	29.64	27.69	28.67
26	CML 50	20.12	14.32	17.22	R	13.50	14.50	14.00	7.56	5.62	6.59
27	CML 51	33.05	29.25	31.15	MR	11.50	12.50	12.00	18.62	19.54	19.08
28	CML 52	55.24	50.21	52.73	MS	7.00	8.50	7.75	27.30	23.40	25.35
29	CML 53	61.25	56.32	58.79	MS	7.50	8.00	7.75	30.22	29.04	29.63
30	CML 54	33.25	31.77	32.51	MR	11.00	12.50	11.75	20.51	19.65	20.08
31	CML 58	37.54	28.96	33.25	MR	10.00	11.50	10.75	21.21	21.57	21.39
32	CML 59	19.02	18.14	18.58	R	13.00	14.50	13.75	8.01	6.02	7.02
33	CML 61	65.32	59.66	62.49	MS	5.50	6.50	6.00	27.65	24.65	26.15
34	CML 62	38.71	32.01	35.36	MR	10.00	11.50	10.75	18.87	17.69	18.28
35	CML 64	32.54	30.22	31.38	MR	11.00	11.00	11.00	15.64	11.83	13.74
36	CML 65	67.13	61.22	64.18	MS	5.50	6.50	6.00	31.02	28.33	29.68
37	CML 68	37.45	30.98	34.22	MR	10.00	10.50	10.25	17.54	17.69	17.62
38	CML 71	37.54	31.77	34.66	MR	10.50	10.50	10.50	16.32	15.39	15.86
39	CML 74	39.41	33.15	36.28	MR	10.00	12.50	11.25	20.01	18.11	19.06
40	CML 76	52.37	51.93	52.15	MS	7.00	8.50	7.75	25.61	23.33	24.47
41	CML 85	48.32	45.76	47.04	MR	8.00	9.50	8.75	24.68	21.67	23.18
42	CML 86	40.58	36.45	38.52	MR	9.50	11.50	10.50	21.41	18.48	19.95
43	CML 87	66.81	62.45	64.63	MS	6.50	7.50	7.00	30.23	27.93	29.08
44	CML 93	18.45	17.98	18.22	R	13.00	13.00	13.00	7.40	5.30	6.35

45	CML 94	27.51	26.58	27.05	R	10.00	12.50	11.25	13.10	11.23	12.17
46	CML 96	35.02	32.54	33.78	MR	8.50	10.00	9.25	16.32	16.21	16.27
47	CML 100	45.93	40.13	43.03	MR	9.00	11.50	10.25	22.36	19.65	21.01
48	CML 101	37.02	30.25	33.64	MR	10.00	12.50	11.25	20.92	17.92	19.42
49	CML 105	38.53	27.85	33.19	MR	10.00	11.00	10.50	18.65	17.87	18.26
50	CML 108	40.69	38.89	39.79	MR	9.50	12.00	10.75	18.58	15.48	17.03
51	CML 113	41.66	30.96	36.31	MR	9.00	11.50	10.25	19.41	17.25	18.33
52	CML 116	34.21	31.37	32.79	MR	11.00	12.50	11.75	14.50	12.60	13.55
53	CML 119	59.18	40.21	49.70	MR	7.50	8.00	7.75	30.96	28.98	29.97
54	CML 121	30.41	31.74	31.08	MR	13.50	13.50	13.50	9.63	7.37	8.50
55	CML 125	33.71	34.17	33.94	MR	10.50	12.50	11.50	15.33	14.44	14.89
56	CML 130	51.38	27.22	39.30	MR	10.50	15.00	12.75	12.08	8.23	10.16
57	CML 132	66.31	45.33	55.82	MS	5.00	7.50	6.25	36.90	33.86	35.38
58	CML 137	50.09	41.74	45.92	MR	7.50	10.00	8.75	26.32	23.45	24.89
59	CML 140	44.51	41.68	43.10	MR	9.00	9.50	9.25	21.07	18.95	20.01
60	CML 142	37.38	30.33	33.86	MR	13.00	13.00	13.00	10.54	8.46	9.50
61	CML 145	40.31	39.12	39.72	MR	10.50	10.50	10.50	15.98	15.68	15.83
62	CML 148	37.32	29.65	33.49	MR	10.00	10.50	10.25	16.31	14.56	15.44
63	CML 151	35.50	26.66	31.08	MR	9.50	10.00	9.75	15.02	14.98	15.00
64	CML 154	37.28	31.65	34.47	MR	10.50	13.00	11.75	16.20	14.27	15.24
65	CML 161	49.00	39.25	44.13	MR	8.00	10.50	9.25	26.59	24.53	25.56
66	CML 165	33.21	30.41	31.81	MR	10.50	11.00	10.75	15.80	13.66	14.73
67	CML 166	79.11	75.13	77.12	S	5.00	6.00	5.50	38.22	36.37	37.30
68	CML 167	45.31	37.71	41.51	MR	8.50	9.50	9.00	24.62	22.37	23.50
69	CML 168	33.95	28.52	31.24	MR	12.50	11.00	11.00	20.74	16.70	18.72
70	CML 173	22.67	12.33	17.50	R	12.00	13.50	12.75	11.63	9.48	10.56
71	CML 176	72.33	70.62	71.48	S	4.50	5.50	5.00	36.21	34.29	35.25
72	CML 177	45.31	30.66	37.99	MR	12.50	10.00	11.00	19.54	17.54	18.54
73	CML 179	37.35	29.26	33.31	MR	13.00	9.50	10.00	19.34	19.07	19.21
74	CML 181	41.81	33.84	37.83	MR	9.50	8.50	9.00	24.74	22.64	23.69
75	CML 183	53.62	36.33	44.98	MR	7.00	9.50	8.25	28.65	24.53	26.59
76	CML 184	32.15	35.27	33.71	MR	12.50	8.50	8.50	20.32	18.43	19.38
77	CML 186	36.91	32.02	34.47	MR	10.00	12.00	11.00	22.51	17.63	20.07
78	CML 190	50.87	35.81	43.34	MR	7.50	13.50	10.50	27.96	20.51	24.24
79	CML 191	7.01	11.69	9.35	R	15.00	16.50	15.75	3.54	2.43	2.99
80	CML 192	34.92	29.33	32.13	MR	15.50	9.00	9.50	16.32	15.62	15.97
81	CML 196	56.31	40.33	48.32	MR	6.50	8.50	7.50	30.45	27.65	29.05
82	CML 197	39.65	33.82	36.74	MR	13.00	9.50	9.50	20.47	17.45	18.96
83	CML 204	55.27	47.21	51.24	MS	7.50	8.00	7.75	31.32	29.46	30.39
84	CML 205	40.61	33.04	36.83	MR	9.50	12.00	10.75	25.12	23.00	24.06
85	CML 208	33.85	30.54	32.20	MR	10.50	10.50	11.00	19.53	17.32	18.43
86	CML 209	37.87	33.98	35.93	MR	10.00	11.50	10.75	23.41	19.36	21.39
87	CML 213	39.42	31.22	35.32	MR	9.50	11.50	10.50	26.99	24.93	25.96
88	CML 214	37.51	28.23	32.87	MR	9.50	12.00	10.75	26.13	24.09	25.11
RC	SKV-50	15.11	8.64	11.88	R	14.50	16.00	15.25	5.50	4.07	4.79
SC	CM-202	76.25	75.31	75.78	S	6.50	6.00	6.25	30.51	29.54	30.03
CD		1.72	1.87	1.92		2.01	2.14	2.51	2.77	2.81	2.99
S. Em		5.03	5.34	5.60		6.04	6.30	7.05	8.54	8.76	9.03

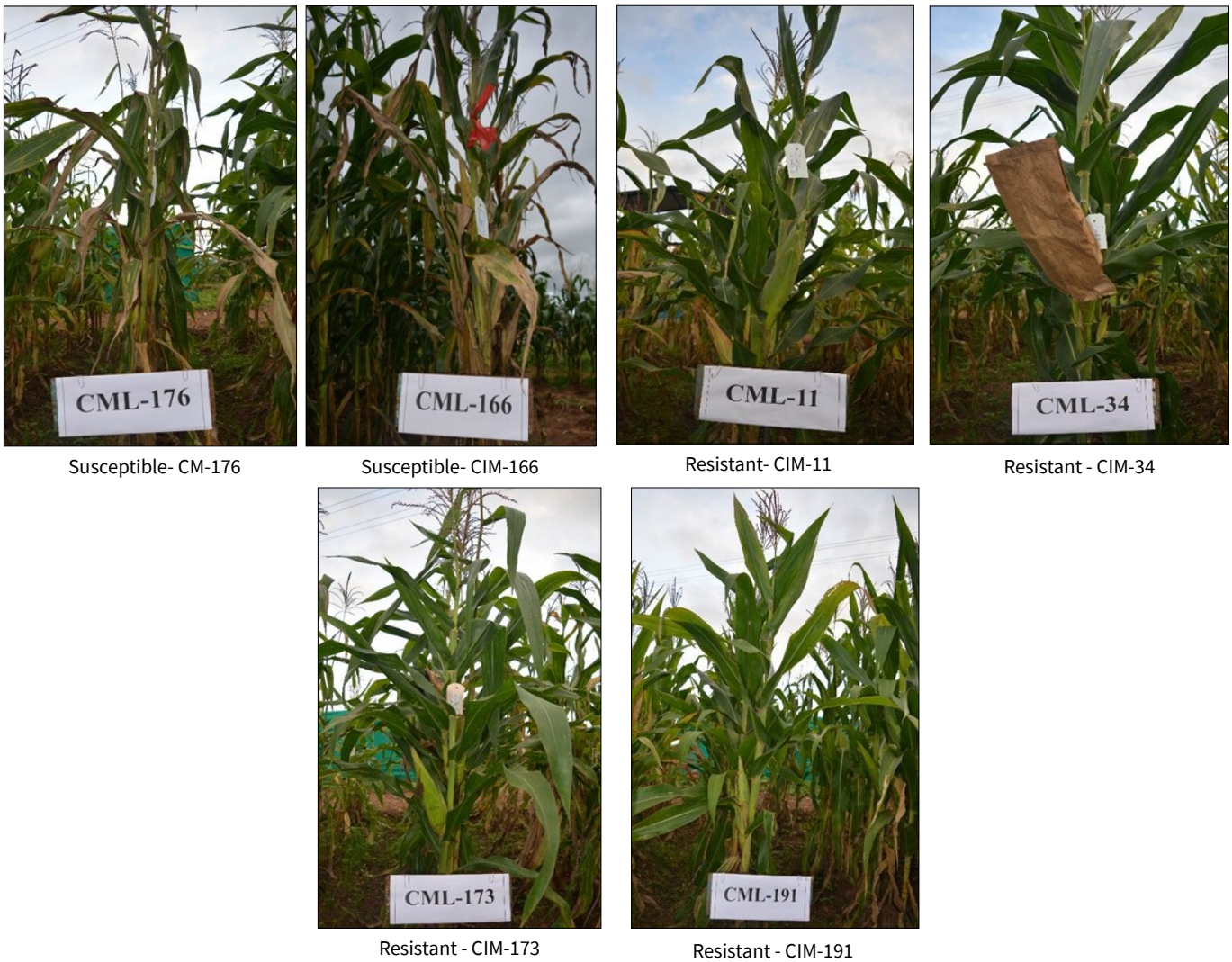
R-Resistant; MR-Moderately resistant; MS-Moderately susceptible; S-Susceptible

Table 3. Categorization of maize inbreds based on their response to TLB

Disease reaction	Inbred lines	No. of entries
Resistant (Score: ≤3.0)	CML 11, CML 34, CML 50, CML 59, CML 93, CML 94, CML 173, CML 191, SKV-50	9
Moderately resistant (Score: 3.1-5.0)	CML 3, CML 8, CML 10, CML 15, CML 16, CML 19, CML 20, CML 23, CML 29, CML 30, CML 31, CML 32, CML 35, CML 36, CML 41, CML 51, CML 54, CML 58, CML 62, CML 64, CML 68, CML 71, CML 74, CML 85, CML 86, CML 96, CML 100, CML 101, CML 105, CML 108, CML 113, CML 116, CML 119, CML 121, CML 125, CML 130, CML 137, CML 140, CML 142, CML 145, CML 148, CML 151, CML 154, CML 161, CML 165, CML 167, CML 168, CML 177, CML 179, CML 181, CML 183, CML 184, CML 186, CML 190, CML 192, CML 196, CML 197, CML 205, CML 208, CML 209, CML 213, CML 214	62
Moderately Susceptible (Score: 5.1-7.0)	CML 12, CML 13, CML 17, CML 21, CML 24, CML 37, CML 44, CML 48, CML 52, CML 53, CML 61, CML 65, CML 76, CML 87, CML 132, CML 204	16
Susceptible (Score: >7.0)	CML 166, CML 176, CM-202	3

a. *Kharif* - 2024 b. *Kharif* - 2025

Fig. 1. Field view of maize germplasm screening against TLB during 2024 (a) and 2025 (b).



Susceptible- CM-176 Susceptible- CIM-166 Resistant- CIM-11 Resistant - CIM-34

Resistant - CIM-173 Resistant - CIM-191

Fig. 2. Reaction of maize germplasm against TLB during 2024 and 2025.

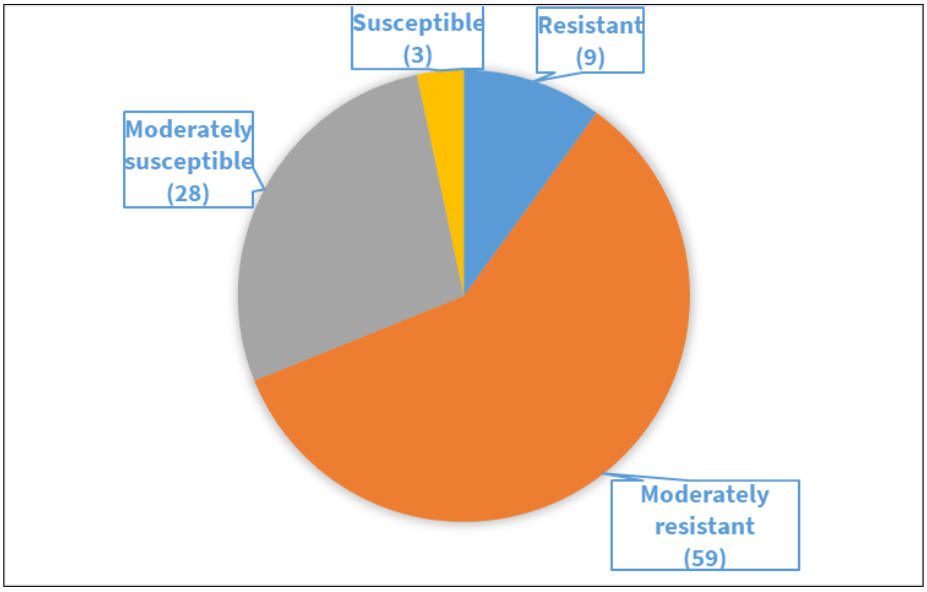


Fig. 3. Frequency distribution of inbreds for TLB disease response.

Table 4. Seasonal weather conditions during *Kharif* 2024 and 2025 at ZARS, V.C. Farm, Mandya

Weather parameter	*Kharif* 2024	*Kharif* 2025
Total rainfall (mm)	812 mm	645 mm
Number of rainy days	38	27
Mean maximum temperature (°C)	29.8°C	30.4°C
Mean minimum temperature (°C)	21.4°C	21.1°C
Mean relative humidity (%)	78%	72%
Average morning RH (%)	88%	83%
Average afternoon RH (%)	68%	61%
Mean wind speed (km/hr)	5.1	4.7

potential for use in breeding programme focused on combating new pathogen races and minimising the susceptibility of current resistant varieties. Furthermore, the findings from this study can support the improvement of maize germplasm and hybrid development through population enhancement initiatives, ultimately contributing to more sustainable yield gains.

Conclusion

The evaluation of 88 maize inbreds over 2 seasons under artificial epiphytotic conditions demonstrated clear and consistent variations in their reactions to TLB. Nine inbreds consistently exhibited strong and stable resistance, reflected in low PDI values and delayed symptom expression, establishing them as elite donors for resistance breeding. Fifty-three lines displayed moderate resistance, offering a valuable pool of minor genes to reinforce population-level resilience. In contrast, CML 166, CML 176 and the susceptible check CM-202 displayed clear susceptibility, with PDI values of 70 % or higher and rapid lesion progression, making them reliable susceptible benchmarks. The consistency of these responses across different seasons highlights the robustness of the screening method and offers a strong genetic base for developing TLB-resistant maize varieties. These identified resistant and susceptible inbreds can be effectively utilised in downstream applications such as hybrid development, pre-breeding programmes and gene introgression pipelines aimed at enhancing durable TLB resistance in maize.

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Authors' contributions

AB performed writing, review, editing of the original draft, validation, formal analysis, data curation and conceptualisation. NM, MB, SKCM, KRG, GB, CRJB and BM contributed to review, editing, visualisation, supervision, resources, methodology, investigation, data curation and conceptualisation. LHC made review and editing, supervision, formal analysis and conceptualisation. NN made review, editing, supervision, resources, formal analysis and conceptualisation. MP made review and editing, resources and conceptualisation. All authors read and approved the final version of manuscript.

Compliance with ethical standards

Conflict of interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this research paper.

Ethical issues: None

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