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# Screening of maize genotypes for their resistance against *Turcicum* leaf blight (*Exserohilum turcicum*) in maize

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**Abstract**
A field experiment was conducted at the Main Maize Research Station, Anand Agricultural University, Godhra, during the *kharif* seasons from 2019 to 2024 to evaluate maize genotypes for resistance against *Turcicum* leaf blight (TLB) caused by *Exserohilum turcicum* under artificial inoculation conditions. The experiment utilized a randomized plot design with two replications. During the study period, 46 maize genotypes were assessed based on a leaf damage rating scale of 1-9. Among the genotypes screened, IGPHC 1203, GWH 1230, I-07-66-2-2, GWC 1210, and HKI-287-1 demonstrated resistance to TLB, with disease index ratings between 1.0 and 3.0. Conversely, genotypes GWHQPM-0922, GWHQPM-0929, GYL-11, and GYL-6 were highly susceptible, with ratings exceeding 7.0. These results highlight significant genetic variability in TLB resistance among the maize genotypes. Future breeding programs should focus on enhancing TLB resistance to improve maize resilience and sustainability.

**Keywords:** Germplasms, screening, resistance, *Turcicum* leaf blight

## Introduction
Maize is (*Zea mays* L.) is the third most important cereals next to rice and wheat in the world as well in India, contributing about 20 percent share of worlds total cereal production. Maize is being consumed both as food and fodder crop and also required by various industries in India. Maize is considered as the "Queen of Cereals" because of its high production potential and wider adoptability. The major maize produce countries in the world are USA, China, South and Central Africa, Argentina, Brazil and Mexico. In India, the important maize growing states are Utter Pradesh, Bihar, Rajasthan, Madhya Pradesh, Punjab, Karnataka, Himachal Pradesh and Andhra Pradesh. In India 45 to 48% of Maize produced is consume by human and the rest is use in cattle and poultry feed and by the starch and oil industries.

In world, maize occupies an area of 199.9 million ha with the production of 1162.9 million tones and productivity of 5815 kg per ha. In India, maize is grown over an area of 9.56 million ha with the production of 28.76 million tones and productivity is 3006 kg ha-1 (Agricultural statistics, 2020). The area under maize crop in Gujarat is about 3.88 lakh ha. The production of 6.67 lakh tones and productivity of 1716.32 kg $ha^{-1}$ (2020 - 21).

A variety of biotic stresses, such as disease incidence, insects/pests, and weed problems like *Striga* spp., are common in tropical maize-growing areas. Foliar diseases, in particular, cause significant losses. The *Turcicum* leaf blight, commonly known as northern leaf blight, is a foliar disease of maize caused by the *ascomycetes* fungus, *Setosphaeria turcicaand* its conidial stage *Exserohilum turcicum* (Pass.) Leonard and Suggs. (syn. *Heliminthosporium Turcicum* Pass) affects the photosynthesis and reduces kernel yield to an extent of 28 to 91%". The disease is characterized by long elliptical, grayish green or brown leaf lesions which emerge first on the lower leaves and gradually extend throughout the foliage. If the disease starts at an early stage, it causes premature death of blighted leaves. As a result, the crop loses their nutritive value as fodder, have reduced germination capacity, vigor, grain yield and total sugar content has restricted starch formation, chaffy kernels and infected plants are liable to infection with stalk rots. "The disease is prevalent in Karnataka, Bihar, Himachal Pradesh, Andhra Pradesh and Maharashtra". "Several disease management options have been recommended to reduce

the impact of maize foliar diseases. Among these practices, planting of resistant cultivars can effectively reduce the rate of disease development and is widely recommended. Breeding for resistance is a practical, cost-effective means to manage the disease". The development of resistance against *Turcicum* leaf blight have large effect on the maize crop improvement programmes.

**Methodology**

The experiment was conducted at the Main Maize Research Station (MMRS), Anand Agricultural University (AAU), Godhra, Gujarat, India during *Kharif* season of 2019-2023. The study evaluated 46 maize genotypes included a mix of white kernal and yellow kernal maize genotypes. The white genotypes were CML-186, CML-293, GWL-8, GWL-12, GWL-27, GWL-28, GWH-1405, GWH-0330, GWH-1005, GWH-0712, GWH-1230, I-07-30-2-2, I-07-66-2-2, GWHQPM-0916, GWHQPM-0922, GWHQPM-0929, GWC-1210, GWC-1258, GWH-1257, with GAWMH-2 as the resistant check and CM-202 as the susceptible check. The yellow kernel genotypes included GYL-11, GYL-9, LTP-1-1, I-07-63-1-2, I-07-63-36-1, CML-482, GYL-4, GYL-7, GYL-8, GYL-12, CM-104, GYL-6, HKI-287-1, HKI-287-2, GYH-363, GYH-0652, GYH-1407, GYH-1408, IGPHC-1202, GYHQPM-0910, GYHQPM-0912, IGPHC-1404, IGPHC-1201, IGPHC-1203, IGPHC-1401, GYC-9006, CML-307 with GAYMH-1 as the resistant check and CM-202 as the susceptible check for resistance against *Turcicum* leaf blight (TLB) caused by *Exserohilum turcicum* under artificial inoculation conditions. A Randomized Block Design (RBD) with two replications was utilized. Each of maize inbred lines/ cultivars has been sown in two rows of 5 m length with spacing 60 X 20 cm by following all standard agronomic practices except plant protection.

Disease resistance was assessed using a modified 9-point disease index scale (1-9) with the percent disease intensity (PDI) calculated from disease initiation to harvest. Observations were recorded from 10 randomly selected plants from each genotype. The disease scoring was based on the scale developed by Payak and Sharma (1983). The rating scale ranged from 1.0 (nil to very slight infection, ≤10% diseased leaf area) to 9.0 (very heavy infection, >80% diseased leaf area). Genotypes were classified as resistant (R) with scores ≤3.0 and PDI ≤33.33, moderately resistant (MR) with scores 3.1-5.0 and PDI 33.34-55.55, moderately susceptible (MS) with scores 5.1-7.0 and PDI 55.56-77.77, and susceptible (S) with scores >7.0 and PDI >77.77. This methodology allowed for the identification of genotypes with significant resistance to TLB, which can inform future breeding programs aimed at enhancing maize resilience against this disease.

**Results and Discussion**

The evaluation of 46 maize genotypes for resistance against *Turcicum* leaf blight (TLB) caused by *Exserohilum turcicum* over five growing seasons (*kharif*-2019 to *kharif*-2023) revealed significant variability in disease resistance. The results are summarized in Table 1, showing scores, percent disease intensity (PDI), and the resulting ratings for each genotype across the five years.

**Disease Ratings**

Out of the 46 genotypes, five were classified as resistant (R) with a PDI ≤33.33, twenty-two as moderately resistant (MR) with a PDI between 33.34-55.55, fifteen as moderately susceptible (MS) with a PDI between 55.56-77.77, and four as susceptible (S) with a PDI >77.77.

**Resistant Genotypes**

The genotypes GWH-1230, I-07-66-2-2, GWC-1210, HKI-287-1, and IGPHC-1203 consistently exhibited resistance across all seasons, maintaining PDI values below 33.33.

**Moderately Resistant Genotypes**

Twenty-two genotypes including CML-293, GWL-27, GWH-1405, GWH-0330, GWH-1005, GWH-0712, I-07-30-2-2, GWHQPM-0916, GWC-1258, GWH-1257, LTP-1-1,GYL-4, GYL-7, CM-104, HKI-287-2, GYH-363, GYH-2213, GYH-1408, IGPHC-1202, GYH-2217, GYHQPM-0912 and IGPHC-1401 were classified as moderately resistant. These genotypes showed a balance of low to moderate PDI, indicating a stable resistance to TLB.

**Moderately Susceptible Genotypes**

Fifteen genotypes such as CML-186, GWL-8, GWL-12, GWL-28, GYL-9 I-07-63-1-2, I-07-63-36-1, CML-482, GYL-8, GYL-12, GYH-1407, IGPHC-1404, IGPHC-1201, GYC-9006 and CML-307 displayed moderate susceptibility with PDI values ranging from 55.56 to 77.77. These genotypes exhibited higher disease intensity but did not reach the level of high susceptibility.

**Susceptible Genotypes**

Four genotypes, including GWHQPM-0922, GWHQPM-0929, GYL-11 and GYL-6 were highly susceptible to TLB with PDI values exceeding 77.77. These genotypes showed very high disease intensity indicating poor resistance.

The present findings are in corroborative with the studies of Wani *et al*. (2017) [11], who evaluated sixty maize genotypes against TLB disease using 1-5 disease rating scale. Among them, two inbred lines *viz*., NAI-112 and NAI-147 and one hybrid i.e., HQPM-1 were found resistant with pooled disease intensity of 4.12 percent, 4.04 percent and 4.38 percent respectively. DKC 7074, DKC 9108, DKC 9106 with disease score 2.0 were found to show moderately resistant reaction. Four inbred lines, *viz*., KDM 381 A, KDM 918 A, NAI-152 and NAI-167 were found susceptible with pooled disease intensity of 52.82 percent, 51.02 percent, 58.58 percent and 61.33 percent respectively. The remaining genotypes were moderately resistant to moderately susceptible. Harlapur *et al*. (2008) [6] conducted field experiment to study the TLB response of thirty maize genotypes based on latent period, lesion density, lesion size, apparent rate of infection and area under disease progress curve (AUDPC). The genotypes *viz*., All-rounder, IB- 8501, Cargill 900M, Hi shell, NAC- 6004, C111, KH- 517, Kaveri 235 and NK -6240 were identified as slow blighters. Thus from the present investigation, new sources of resistance were identified through artificial epiphytotics. This can cater to the resistance breeding programme by combating with the new races of pathogens that would be emerging continuously and susceptibility of some resistance sources. This result would also be useful in improvement of maize hybrids through population improvement programmes for sustainable productivity.

**Conclusion**

This study identified maize genotypes with varying levels of resistance to *Turcicum* leaf blight, with five genotypes classified as resistant, twenty-two as moderately resistant, fifteen as moderately susceptible, and four as susceptible. The consistently resistant genotypes, GWH-1230, I-07-66-2-2, GWC-1210, HKI-

287-1, and IGPHC-1203, demonstrated stable resistance across different seasons, making them valuable candidates for breeding programs aimed at enhancing TLB resistance in maize. The findings highlight the importance of continuous evaluation of maize genotypes for disease resistance to ensure the development of resilient maize varieties capable of withstanding TLB, thereby ensuring stable yields and food security.

**Table 1:** Screening of maize genotypes for their resistance against *Turcicum* leaf blight (*Exserohilum turcicum*) of maize

| S. N. | Genotypes | *Kharif*-2019 | | | *Kharif* - 2020 | | | *Kharif* -2021 | | | *Kharif* -2022 | | | *Kharif* -2023 | | | Overall rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PDI | Score | Rating | PDI | Score | Rating | PDI | Score | Rating | PDI | Score | Rating | PDI | Score | Rating | Rating |
| 1 | CML-186 | 51.11 | 4 | MR | 51.11 | 4 | MR | 45.56 | 4 | MR | 45.55 | 3 | MR | 73.33 | 6 | MS | MS |
| 2 | CML-293 | 12.22 | 1 | R | 31.11 | 2 | R | 40 | 3 | MR | 35.55 | 3 | MR | 42.22 | 3 | MR | MR |
| 3 | GWL-8 | 14.44 | 1 | R | 28.89 | 2 | R | 37.78 | 3 | MR | 35.55 | 3 | MR | 76.11 | 6 | MS | MS |
| 4 | GWL-12 | 15.56 | 1 | R | 28.89 | 2 | R | 36.67 | 3 | MR | 41.11 | 3 | MR | 62.22 | 5 | MS | MS |
| 5 | GWL-27 | 17.78 | 1 | R | 32.22 | 2 | R | 34.44 | 3 | MR | 43.33 | 3 | MR | 25.56 | 2 | R | MR |
| 6 | GWL-28 | 28.89 | 2 | R | 33.33 | 3 | R | 36.67 | 3 | MR | 56.66 | 5 | MS | 31.11 | 2 | R | MS |
| 7 | GWH-1405 | 18.89 | 1 | R | 28.89 | 2 | R | 40 | 3 | MR | 32.22 | 3 | MR | 16.67 | 1 | R | MR |
| 8 | GWH-0330 | 11.11 | 1 | R | 30 | 2 | R | 32.22 | 2 | R | 43.33 | 3 | MR | 20.56 | 1 | R | MR |
| 9 | GWH-1005 | 17.78 | 1 | R | 53.33 | 4 | MR | 38.89 | 3 | MR | 38.88 | 3 | MR | 30.56 | 2 | R | MR |
| 10 | GWH-0712 | 20 | 1 | R | 31.11 | 2 | R | 35.56 | 3 | MR | 35.55 | 3 | MR | 40 | 3 | MR | MR |
| 11 | GWH-1230 | 15.56 | 1 | R | 28.89 | 2 | R | 27.78 | 2 | R | 28.88 | 2 | R | 19.44 | 1 | R | R |
| 12 | I-07-30-2-2 | 11.11 | 1 | R | 32.22 | 2 | R | 32.22 | 2 | R | 37.77 | 3 | MR | 51.11 | 4 | MR | MR |
| 13 | I-07-66-2-2 | 20 | 1 | R | 28.89 | 2 | R | 27.78 | 2 | R | 27.77 | 2 | R | 33.33 | 3 | R | R |
| 14 | GWHQPM-0916 | 15.56 | 1 | R | 26.67 | 2 | R | 38.89 | 3 | MR | 44.44 | 4 | MR | 40.56 | 3 | MR | MR |
| 15 | GWHQPM-0922 | 13.33 | 1 | R | 33.33 | 3 | R | 47.78 | 4 | MR | 36.66 | 3 | MR | 85.56 | 7 | S | S |
| 16 | GWHQPM-0929 | 11.11 | 1 | R | 26.67 | 2 | R | 51.11 | 4 | MR | 37.77 | 3 | MR | 81.11 | 7 | S | S |
| 17 | GWC-1210 | 22.22 | 2 | R | 27.78 | 2 | R | 27.78 | 2 | R | 28.88 | 2 | R | 32.22 | 2 | R | R |
| 18 | GWC-1258 | 11.11 | 1 | R | 28.89 | 2 | R | 53.33 | 4 | MR | 35.55 | 3 | MR | 42.22 | 3 | MR | MR |
| 19 | GWH-1257 | 45.56 | 4 | MR | 48.89 | 4 | MR | 62.22 | 5 | MS | 56.66 | 5 | MS | 50 | 4 | MR | MR |
| Res. check | GAWMH-2 | 25.97 | 2 | R | 25.56 | 2 | R | 32.22 | 2 | R | 26.67 | 2 | R | 19.44 | 1 | R | R |
| Sus. check | CM-500 | 81.11 | 7 | S | 75.56 | 6 | S | 75.56 | 6 | MS | 63.33 | 5 | S | 70.55 | 6 | S | S |
| 20 | GYL-11 | 15.56 | 1 | R | 25.56 | 2.3 | R | 31.11 | 2 | R | 50 | 4 | MR | 83.33 | 8 | S | S |
| 21 | GYL-9 | 12.22 | 1 | R | 26.67 | 2.4 | R | 30 | 2 | R | 48.88 | 4 | MR | 60 | 5 | MS | MS |
| 22 | LTP-1-1 | 13.33 | 1 | R | 33.33 | 3 | R | 28.89 | 2 | R | 42.22 | 3 | MR | 35.56 | 3 | MR | MR |
| 23 | I-07-63-1-2 | 14.44 | 1 | R | 26.67 | 2.4 | R | 44.44 | 4 | MR | 40 | 3 | MR | 68.89 | 6 | MS | MS |
| 24 | I-07-63-36-1 | 15.56 | 1 | R | 42.22 | 3.8 | MR | 36.67 | 3 | MR | 31.11 | 2 | R | 56.67 | 5 | MS | MS |
| 25 | CML-482 | 17.78 | 1 | R | 26.67 | 2.4 | R | 34.44 | 3 | MR | 41.11 | 3 | R | 56.67 | 5 | MS | MS |
| 26 | GYL-4 | 13.33 | 1 | R | 25.56 | 2.3 | R | 45.56 | 4 | MR | 54.44 | 4 | MR | 51.11 | 4 | MR | MR |
| 27 | GYL-7 | 11.11 | 1 | R | 31.11 | 2.8 | R | 31.11 | 2 | MR | 32.22 | 2 | MR | 38.89 | 3 | MR | MR |
| 28 | GYL-8 | 12.22 | 1 | R | 26.67 | 2.4 | R | 37.78 | 3 | MR | 33.33 | 3 | R | 67.78 | 6 | MS | MS |
| 29 | GYL-12 | 13.33 | 1 | R | 32.22 | 2.9 | R | 46.67 | 4 | MR | 27.77 | 2 | R | 75.56 | 6 | MS | MS |
| 30 | CM-104 | 15.56 | 1 | R | 26.67 | 2 | R | 26.67 | 2 | MR | 35.55 | 3 | R | 51.11 | 4 | MR | MR |
| 31 | GYL-6 | 52.92 | 4 | MR | 31.11 | 2 | R | 53.33 | 4 | MR | 47.78 | 4 | MR | 79.44 | 7 | S | S |
| 32 | HKI-287-1 | 11.11 | 1 | R | 26.67 | 2 | R | 31.11 | 2 | R | 27.77 | 2 | R | 33.33 | 3 | R | R |
| 33 | HKI-287-2 | 51.11 | 4 | MR | 53.33 | 4 | MR | 35.56 | 3 | MR | 32.22 | 2 | R | 43.89 | 3 | MR | MR |
| 34 | GYH-363 | 13.33 | 1 | R | 54.44 | 4.9 | MR | 27.78 | 2 | R | 31.11 | 2 | R | 34.44 | 3 | MR | MR |
| 35 | GYH-2213 | 30 | 2 | R | 26.67 | 2 | R | 44.44 | 4 | MR | 30 | 2 | R | 20.56 | 1 | R | MR |
| 36 | GYH-1407 | 13.33 | 1 | R | 33.33 | 3 | R | 57.78 | 5 | MS | 53.33 | 4 | MR | 19.44 | 1 | R | MS |
| 37 | GYH-1408 | 14.44 | 1 | R | 26.67 | 2 | R | 47.78 | 4 | MR | 46.66 | 4 | MR | 23.89 | 2 | R | MR |
| 38 | IGPHC-1202 | 13.33 | 1 | R | 48.89 | 4 | MR | 40 | 3 | MR | 38.88 | 3 | MR | 32.78 | 2 | R | MR |
| 39 | GYH-2217 | 12.22 | 1 | R | 28.89 | 2 | R | 36.67 | 3 | MR | 37.77 | 3 | MR | 27.22 | 2 | R | MR |
| 40 | GYHQPM-0912 | 30 | 2 | R | 24.44 | 2 | R | 42.22 | 3 | MR | 31.11 | 2 | R | 22.22 | 2 | R | MR |
| 41 | IGPHC-1404 | 12.22 | 1 | R | 27.78 | 2 | R | 42.22 | 3 | MR | 28.88 | 2 | R | 63.33 | 5 | MS | MS |
| 42 | IGPHC-1201 | 52.22 | 4 | MR | 53.33 | 4 | MR | 45.56 | 4 | MR | 46.66 | 4 | MR | 61.67 | 5 | MS | MS |
| 43 | IGPHC-1203 | 28.89 | 2 | R | 30 | 2 | R | 30 | 2 | R | 27.77 | 2 | R | 31.11 | 2 | R | R |
| 44 | IGPHC-1401 | 36.67 | 3 | MR | 52.22 | 4 | MR | 41.11 | 3 | MR | 54.44 | 4 | MR | 50.56 | 4.55 | MR | MR |
| 45 | GYC-9006 | 62.22 | 5 | MS | 73.33 | 6 | R | 60 | 5 | MS | 62.22 | 5 | MR | 67.22 | 6 | MS | MS |
| 46 | CML-307 | 44.44 | 4 | MR | 51.11 | 4 | MR | 57.78 | 5 | MS | 56.66 | 5 | MR | 80 | 7 | MS | MS |
| Res. check | GAYMH-1 | 25.56 | 2 | R | 24.44 | 2 | R | 28.89 | 2 | R | 31.11 | 2 | R | 18.89 | 1 | R | R |
| Sus. check | CM-202 | 80 | 7 | S | 78.89 | 7 | S | 64.44 | 5 | MS | 62.22 | 5 | MS | 72.78 | 6 | MS | S |

**Table 2:** Disease reaction of maize genotypes against *Turcicum* leaf blight of maize based on rating scale

| Disease reaction | Genotypes | Numbers of genotypes |
|---|---|---|
| Resistant (PDI: ≦33.33) | GWH-1230, I-07-66-2-2, GWC-1210, HKI-287-1, IGPHC-1203 | 05 |
| Moderately Resistant (PDI:33.33-55.55) | CML-293, GWL-27, GWH-1405, GWH-0330, GWH-1005, GWH-0712, I-07-30-2-2, GWHQPM-0916, GWC-1258, GWH-1257, LTP-1-1,GYL-4, GYL-7, CM-104, HKI-287-2, GYH-363, GYH-2213, GYH-1408, IGPHC-1202, GYH-2217, GYHQPM-0912, IGPHC-1401 | 22 |
| Moderately susceptible (PDI:55.56-77.77) | CML-186, GWL-8, GWL-12, GWL-28, GYL-9 I-07-63-1-2, I-07-63-36-1, CML-482, GYL-8, GYL-12, GYH-1407, IGPHC-1404, IGPHC-1201, GYC-9006, CML-307 | 15 |
| susceptible (PDI:>77.77) | GWHQPM-0922, GWHQPM-0929, GYL-11, GYL-6 | 04 |
| Total | | 46 |

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