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EVALUATION OF FUNGICIDES AND ORGANIC COMPOUNDS FOR THE MANAGEMENT OF *HELMINTHOSPORIUM* LEAF BLIGHT IN BARNYARD MILLET

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ABSTRACT

Helminthosporium Leaf Blight (HLB) caused by *Helminthosporium crusgalli* is a major disease constraining productivity of barnyard millet, particularly under rainfed situations. The present investigation was carried out during *kharif*, 2021-22 and 2022-23 at Regional Agricultural Research Station, Nandyal under All India Coordinated Research Project on Small Millets to evaluate the efficacy of fungicides against HLB under field conditions. The experiment was laid out in a Randomized Block Design (RBD) with seven treatments and three replications. Among the treatments, Hexaconazole (0.2%) applied twice recorded significantly higher grain yield (2,094 kg ha^{-1}), maximum gross returns (Rs. 52,350 ha^{-1}), and highest Benefit–Cost ratio (3.0). Azoxystrobin (0.1%) resulted in the lowest disease severity (37.9 % PDI), followed closely by Hexaconazole (38.0% PDI). The untreated control recorded maximum disease severity (54.5% PDI) and lowest yield (1,463 kg ha^{-1}). The results indicated that two sprays of Hexaconazole (0.2%) effectively reduced the disease severity with enhanced yield and profitability. Hence, Hexaconazole is recommended for effective management of *Helminthosporium* Leaf Blight in barnyard millet under field conditions.

Keywords **:** Barnyard millet, *Helminthosporium* leaf blight, fungicides, Hexaconazole, Azoxystrobin.

Introduction

Barnyard millet (*Echinochloa frumentacea* (Roxb.) is an important small millet cultivated in India and several other countries for both grain and fodder purposes. India is one of the leading country in barnyard millet production, which cultivated in an area of 0.146 million hectares with a yield of 0.147 million metric tons (Singh *et al.*, 2025). In India, it is predominantly grown in Madhya Pradesh, Uttarakhand, Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra and Bihar, mainly by small and marginal farmers under rainfed ecosystems. Despite its adaptability and nutritional importance, productivity remains low due to several biotic stresses, among which *Helminthosporium* Leaf Blight (HLB) is a serious constraint.

HLB, caused by *Helminthosporium crus-galli*, manifests as leaf spots and progressive blighting, leading to reduced photosynthetic area and grain yield. Screening of barnyard millet genotypes during 2018–2020 indicated that most entries were moderately susceptible to highly susceptible, necessitating chemical management strategies. In wheat, fungicides such as propiconazole and epoxiconazole have been reported to effectively manage *Helminthosporium* leaf blight and increase yield (Duveiller *et al.*, 2005). However, limited information is available regarding fungicidal management of HLB in barnyard millet. Therefore, the present study was undertaken to evaluate the efficacy of selected fungicides against *Helminthosporium* Leaf Blight in barnyard millet under field conditions.

Materials and Methods

Experimental Site

The experiment was conducted during *kharif*, 2021-22 and 2022-23 at Regional Agricultural Research Station, Nandyal, Andhra Pradesh, India. The trial was laid out in a Randomized Block Design (RBD) with three replications, using the susceptible variety LDR-1 as a check. Each experimental plot consisted of 10 rows of 3 m length, with a spacing of 22.5 cm × 7.5 cm maintained between rows and plants, respectively. A fertilizer dose of 40: 20:0 kg of N: P : K ha^{-1} was applied uniformly to all treatments in the experimental plots. In total, seven treatments were evaluated for their efficacy against *Helminthosporium* Leaf Blight in barnyard millet. The treatment details were as follows:

Table 1 : Details of the Treatments

S.No	Treatments
1	Azoxystrobin 23%SC @ 0.1%
2	Propiconazole @ 0.1%
3	Hexaconazole (0.2%)
4	Mancozeb + Carbendazim (SAAF/companion) @0.2%
5	NSKE @ 0.5%
6	Panchagavya (Seed Treatment + Foliar application)
7	Control Without any fungicidal spray (Check)

*All treatments were given as two sprays first at disease initiation and second at 15 days thereafter.

Data recorded

Observations were recorded on Percent Disease Index (PDI) to assess the severity of *Helminthosporium* Leaf Blight under different treatments. Grain yield was measured and expressed in kg ha^{-1}. Economic parameters including gross returns (Rs. ha^{-1}) and benefit–cost (B:C) ratio were calculated to evaluate the profitability of each treatment. The collected data were subjected to statistical analysis using standard analysis of variance (ANOVA) procedures appropriate for a Randomized Block Design (RBD) to determine the significance of treatment effects.

Results and Discussion

Significant differences were observed among treatments for disease severity and yield.

Disease Severity

The pooled analysis of two consecutive seasons (from Table-2 & Figure-1) clearly indicated that all fungicidal treatments significantly reduced the disease severity of *Helminthosporium* Leaf Blight compared to the untreated control. Among the treatments evaluated, Azoxystrobin 23% SC @ 0.1% applied as two sprays recorded the lowest leaf blight severity with a Percent Disease Index (PDI) of 37.90, indicating its strong protective and curative action against the pathogen. Sharavanan (2024) reported among the treatments, fungicide azoxystrobin 23% SC @ 0.1% has recorded the minimum growth of the pathogen. This was closely followed by Hexaconazole (0.2%) with a PDI of 38.00, and Propiconazole @ 0.1% with a PDI of 39.70, demonstrating the effectiveness of systemic triazole fungicides in suppressing disease development.

The combined application of Mancozeb + Carbendazim (SAAF) resulted in a moderate reduction of disease severity, recording a PDI of 42.90. Although this treatment was significantly better than the untreated control, its efficacy was lower than that of the systemic fungicides, possibly due to its predominantly protective mode of action (Paramasivam *et al.,* 2024).

Botanical and organic treatments were comparatively less effective in controlling *Helminthosporium* Leaf Blight. NSKE @ 0.5% recorded a PDI of 50.0, while Panchagavya (seed treatment followed by two foliar sprays) showed a PDI of 51.20. These treatments, though eco-friendly, provided only partial suppression of the disease and were unable to maintain disease severity at economically acceptable levels under high disease pressure. The untreated control recorded the highest disease severity with a PDI of 54.50, confirming the destructive nature of *Helminthosporium* Leaf Blight in barnyard millet when no plant protection measures are adopted.

Table 2 : Pooled results for management of *Helminthosporium* leaf blight in Barnyard millet during *kharif*, 2021-22 and 2022-23

S.No	Treatments	Disease Severity (PDI)	Yield (kg/ha)	Gross Returns (Rs.)	B:C ratio
T_1	Azoxystrobin @ 0.1%	37.90 (38.00)	1,888	47,200	2.42
T_2	Propiconazole @ 0.1%	39.70 (39.10)	1,896	47,400	2.72
T_3	Hexaconazole @ 0.2%	38.00 (38.10)	2,094	52,350	3.00
T_4	Mancozeb + Carbendazim @ 0.2%	42.90 (40.90)	1,791	44,775	2.60
T_5	NSKE @ 0.5%	50.00 (45.20)	1,561	39,025	2.24
T_6	Panchagavya (ST+ Foliar application)	51.20 (45.70)	1,498	37,450	1.97
T_7	Control without any fungicidal spray	54.50 (47.60)	1,463	36,575	2.16
	SEm±	0.65	50.13		
	CD @ 5%	2.03	156.1		
	CV (%)	2.67	4.98		

Fig. 1 : Experimental Field view conducted at Regional Agricultural Research Station, Nandyal

Grain Yield

The pooled data over two seasons (2021–22 and 2022–23) revealed significant differences among treatments with respect to grain yield, gross returns, and Benefit–Cost (B:C) ratio, indicating the economic impact of effective management of *Helminthosporium* Leaf Blight in barnyard millet.

Among all treatments, Hexaconazole (0.2%) applied as two sprays recorded the highest grain yield (2,094 kg ha^{-1}). This represents a substantial yield advantage over the untreated control (1,463 kg ha^{-1}), clearly demonstrating the positive influence of effective disease suppression on crop productivity. The higher yield under Hexaconazole treatment may be attributed to better protection of the photosynthetic leaf area and reduced disease progression during critical growth stages (Kale *et al.*, 2020).

Propiconazole (0.1%) and Azoxystrobin (0.1%) were the next best treatments, recording yields of 1,896 kg ha^{-1} and 1,888 kg ha^{-1}, respectively. Though slightly lower than Hexaconazole, these treatments also resulted in considerable yield improvement compared to the control. Mancozeb + Carbendazim (SAAF) produced a moderate yield of 1,791 kg ha^{-1}, indicating satisfactory disease control but comparatively lower effectiveness than systemic triazoles (Yadav *et al.*, 2020). Botanical and organic treatments recorded relatively lower yields. NSKE (0.5%) yielded 1,561 kg ha^{-1}, while Panchagavya recorded 1,498 kg ha^{-1}. Although these treatments were superior to the untreated control, their effectiveness was limited under field conditions with considerable disease pressure (Ramesh and Singh, 2021).

The economic analysis further strengthened these findings. Hexaconazole registered the highest gross returns (Rs. 52,350 ha^{-1}) and the maximum B:C ratio (3.0), making it the most profitable treatment. Propiconazole recorded a B : C ratio of 2.72, followed by Mancozeb + Carbendazim (2.60) and Azoxystrobin (2.42). NSKE (2.24) and Panchagavya (1.97) were comparatively less economical. The untreated control recorded the lowest gross returns (Rs. 36,575 ha^{-1}) and a relatively lower B : C ratio (2.16), highlighting the economic losses associated with unmanaged *Helminthosporium* Leaf Blight.

The present study demonstrated that systemic triazole fungicides effectively reduced *Helminthosporium* Leaf Blight severity and improved grain yield in barnyard millet. Although Azoxystrobin resulted in slightly lower disease severity, Hexaconazole produced higher grain yield and economic returns, suggesting better physiological recovery and yield enhancement. These findings corroborate earlier reports in wheat where triazole fungicides significantly reduced *Helminthosporium* leaf blight severity and enhanced productivity Chowdhury *et al.*, 2021). The superior performance of Hexaconazole may be attributed to its systemic action and longer residual effect. Botanical and organic treatments such as NSKE and Panchagavya were comparatively less effective, though they performed better than the untreated control.

Conclusion

The results of the present study clearly demonstrated that each fungicidal spray significantly reduced the severity of *Helminthosporium* Leaf Blight and improved grain yield and economic returns in barnyard millet. Among the treatments evaluated, Hexaconazole (0.2%) applied twice proved as the most effective and economically feasible option, which gave

a comparable reduction in disease severity (38.00%) and recorded the highest grain yield (2,094 kg ha^{-1}), gross returns (Rs. 52,350 ha^{-1}), and benefit–cost ratio (3.0). Similarly, Propiconazole (0.1%) also performed effectively, recording moderate disease reduction (37.90%) and a high B:C ratio (2.72), it is further confirmed the efficacy of triazole fungicides in managing foliar blight diseases. However, Azoxystrobin (0.1%) recorded the lowest Percent Disease Index (37.90%). In contrast, Mancozeb + Carbendazim provided only moderate control, while botanical and organic treatments such as NSKE and Panchagavya were comparatively less effective under higher disease pressure. The untreated control recorded the highest disease severity and lowest yield, highlighting the substantial yield losses caused by unmanaged *Helminthosporium* Leaf Blight.

Therefore, based on pooled performance over two seasons, two sprays of Hexaconazole (0.2%) are recommended for effective and economical management of *Helminthosporium* Leaf Blight in barnyard millet under field conditions. Adoption of this practice can substantially enhance productivity and profitability for small and marginal farmers cultivating barnyard millet under rainfed ecosystems.

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