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Screening for resistant sources against banded leaf and sheath blight on little millet

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Abstract

Banded leaf and sheath blight (BLSB), caused by *Rhizoctonia solani*, poses a significant risk to little millet (*Panicum sumatrense*) yield, making host plant resistance the most cost-effective and sustainable management strategy. Thirty little millet genotypes, including checks, were evaluated during *Kharif* 2023 under natural epiphytotic conditions at the Agricultural Research Station, Vizianagaram, Andhra Pradesh, using a 1-9 standard evaluation scale. None of the evaluated entries showed complete or high resistance. Nine entries-WV 146, VS33, PPS-98, LMNDL-6, VS43, VS 15, WV 295, IIMR-LM-5208, and the resistant check RLM-208-were categorized as moderately resistant. Twelve entries were susceptible, while nine entries, including the susceptible check RLM-223, were highly susceptible. The resistant check RLM-208 recorded a Per cent Disease Index (PDI) of 17.47% and maximum grain yield (2854.96 kg/ha), whereas RLM-223 recorded a PDI of 79.20% and minimum yield (948.99 kg/ha) among various genotypes evaluated. Identified moderately resistant genotypes serve as criteria for breeding disease-resistant, high-yielding little millet cultivars.

Keywords: Banded leaf and sheath blight, panicum sumatrense, per cent disease index, *Rhizoctonia solani*, screening

Introduction

Little millet (*Panicum sumatrense* Roth ex Roem. and Schult.) is a short-duration (75-110 days) C4 nutri-cereal cultivated in tropical and subtropical South Asia (Dey *et al.*, 2024) ^[4], rich in protein, fiber, B-complex vitamins (niacin, thiamine), and minerals (Fe, Zn, Cu, Mg, Se, P) (FAO, 2023). India is the leading producer (0.22-0.26 M/ha; 0.12-0.13 Mt/year), primarily growing it under rainfed conditions during *kharif*, with contingent potential in late *kharif* or *rabi* (Vetriventhan *et al.*, 2023; Directorate of Economics and Statistics, 2023; ICAR-IIMR, 2024). Major millet-growing states (Madhya Pradesh, Chhattisgarh, Odisha, Tamil Nadu, Karnataka) report yields of 0.4-0.8 t/ha, but national productivity averages only 0.5-0.6 t/ha compared to a potential 2.5-3.0 t/ha due to biotic and abiotic stress (Directorate of Economics and Statistics, 2023; ICAR-IIMR, 2024). Fungal diseases cause 20% to >50% yield losses across growth stages: *Rhizoctonia solani*, *Macrophomina phaseolina*, and *Fusarium* spp. cause seedling damping-off (Patro *et al.*, 2023); *Pyricularia setariae* / *P. grisea*, *Helminthosporium nodulosum* / *Bipolaris* spp., and *Uromyces linearis* cause vegetative foliage damage (Palanna *et al.*, 2023; Tharana Poonacha *et al.*, 2024); while *Ustilago crameri* / *U. paradoxa* and *Sclerospora graminicola* impair reproductive panicles (Dey *et al.*, 2024) ^[4, 5, 8].

Banded Leaf and Sheath Blight (BLSB), caused by *R. solani* Kuhn, is particularly destructive in *kharif* under 25-30°C and 100% relative humidity (Jain & Kumar, 2023; Maddela *et al.*, 2023; Patro *et al.*, 2024; Prasanna *et al.*, 2026). It forms greyish-white lesions with dark margins that coalesce into banded patterns, spreading upward from basal sheaths to induce necrosis, photosynthetic loss, and premature drying (Jain and Kumar, 2023; Poonacha *et al.*, 2026), causing 30%-60% (or 37.4%-63.0%) yield loss and stover quality decline (Ramesh *et al.*, 2023; Patro *et al.*, 2024). Culturally, *R. solani* produces a white-to-brown mycelial mat with sclerotia (Kumar *et al.*, 2025) ^[29, 5, 20, 16, 28, 4, 9, 12, 23, 9, 22, 24, 11]. Microscopically, it lacks asexual conidia,

showing septate hyphae with 90° branching, origin constriction, and an adjacent septum (Sharma *et al.*, 2024; Poonacha *et al.*, 2025). To avoid pesticide hazards, host resistance is vital (Salam *et al.*, 2023; Sowmika *et al.*, 2025); thus, this study evaluated 30 little millet genotypes at ARS, Vizianagaram, to identify BLSB resistance [26, 21, 25, 27].

Materials and methods

A field experiment was conducted against banded blight caused by *R. solani* during Kharif, 2023 at Agricultural Research Station, Vizianagaram. The experiment was laid out in Randomized Block Design (RBD), with 27 varieties which were received from

AICRP (Small millets) along with two checks, replicated three times which was sown in two rows of 3 m length with a spacing of 30 x 10 cm. The recommended agronomic practices and other standard packages of practices were adopted at the time of crop growth period. Disease score was recorded on five randomly selected plants from each genotype/replication. The genotypes of little millet were screened under natural epiphytotic conditions, and no artificial inoculation was made. Infected plants were examined for disease development, and disease severity was assessed based on lesion length using a 1-9 scale (Table 1) at the grain maturity stage (Hariprasanna *et al.*, 2022) [7].

Table 1: Banded blight rating (1-9 scale)

Score	Description	Reaction
1	<1% of plant area covered by lesion	Highly Resistant (HR)
2	1-5% of plant area covered by lesion	Resistant (R)
3	6-10% of plant area covered by lesion	
4	11-20% of plant area covered by Lesion	Moderately Resistant (MR)
5	21-30% of plant area covered by Lesion	
6	31-40% of plant area covered by Lesion	Susceptible (S)
7	41-50% of plant area covered by lesion	
8	51-75% of plant area covered by lesion	Highly Susceptible (HS)
9	>75% of plant area covered by lesion	

Percent Disease Index (PDI) was calculated by using the formula

PDI for severity = $\frac{\text{Sum of all disease ratings}}{\text{Total number of ratings} \times \text{Maximum disease grade}} \times 100$

The genotypes were categorized in to five disease reaction groups based on banded blight severity (Table 3).

Results and discussion

Twenty-eight little millet varieties, along with two checks, i.e., RLM-208 (Resistant) and RLM-223 (Susceptible), were screened for banded leaf and sheath blight (BLSB) reaction. Among the genotypes, none were found to be immune or resistant to *R. solani*, whereas nine entries were found to be moderately resistant, twelve entries were susceptible, and nine entries were found highly susceptible to BLSB disease (Table 3). The resistant check RLM-208 (17.47%) and the susceptible check RLM-223 (79.20%) were recorded as moderately resistant and highly susceptible to banded blight disease, respectively. The per cent disease index of banded blight ranged from 15.73% (VS 15) to 79.20% (RLM-223). The varieties showing lower banded blight disease incidence recorded higher grain yields viz., RLM-208, VS 33, LM NDL 6, VS 43, and WV 295 giving 2854.96, 2463.32, 2378.19, 2250.39, and 2207.82 kg/ha, respectively (Table 2). Previously, (Chouhan, 2014) [3] screened 21 little millet genotypes of different maturity groups and reported five genotypes as resistant, six moderately resistant, eight moderately susceptible, and two susceptible for banded leaf and sheath blight. (Jain and Gupta, 2010) reported the occurrence of BLSB disease on foxtail

millet and barnyard millet from Madhya Pradesh, India, where cultivar RBM 9-4 was found to be free from BLSB and six genotypes namely TNAU 128, TNAU 130, RAU 8, VL 29, VL 220, and RBM 12 were identified as resistant to BLSB. (Patro and Madhuri, 2014) screened 19 little millet genotypes and reported RLM 43 as a resistant genotype and JK 8 as a susceptible genotype. (Nagaraja *et al.*, 2016) reported that all the small millet crops were found infected with *R. solani*, whereas LAVT 19 and LAVT 14 were identified as resistant genotypes. (Patro *et al.*, 2019) reported that IIMR LM-8437-7 with 4.4 per cent severity was found resistant to banded blight when screened among 24 varieties. (Patro *et al.*, 2020) screened 17 entries and reported that all the entries were found to be infected with banded blight disease. (Palanna *et al.*, 2021) screened 21 little millet varieties against banded blight and identified seven resistant varieties. The findings of the current study are in accordance with (Salam *et al.*, 2023), who reported that among 27 entries screened, 12 were moderately resistant to BLSB. These genotypes would be of immense value to breeders involved in developing high-yielding and disease-resistant little millet genotypes [17, 13, 19, 18, 15, 25]. Thirty little millet genotypes were screened against banded leaf and sheath blight caused by *Rhizoctonia solani* along with one resistant and one susceptible variety as a check under natural conditions. No variety was found completely resistant to banded leaf and sheath blight disease during a year of experimentation, and the moderately resistant genotype (s) can be viewed as parental lines in resistance breeding programs.

Table 2: Evaluation of little millet genotypes against sheath blight

S.No	Genotype	BB* (PDI)	Reaction	Yield Kg/ha
1	IIMR-LM-5007	40.37(39.45) d	S	1497.76
2	IIMR LM-5208	25.20(30.13) e	MR	2190.39
3	TNPSU 244	46.28(42.87) c	S	1375.22
4	CLMV-1	40.61(39.59) d	S	1590.32
5	OLM 203	51.30(45.74) c	HS	1220.62
6	BL6	53.14(46.80) c	HS	1163.58
7	TNPSU 242	59.31(50.37) b	HS	1188.50

8	DHLM 36-3	62.04(51.96) b	HS	1089.55
9	JK-8	75.94(60.63) a	HS	965.92
10	WV 309	54.20(47.41) c	HS	1054.39
11	WV 297	38.60(38.41) d	S	1550.90
12	VS 57	50.60(45.34) c	S	1283.53
13	VS 31	34.28(35.84) d	S	1794.17
14	VS 15	15.73(23.93) f	MR	1249.27
15	GPUL 16	56.40(48.68) b	HS	1015.85
16	OLM 217	64.77(53.59) b	HS	1090.76
17	DLM 311	45.29(42.29) c	S	1490.15
18	BLM 19-9-E	33.10(35.12) e	S	1954.47
19	WV 295	27.75(31.79) e	MR	2207.82
20	IIMR LM - 8004	47.35(43.48) c	S	1520.37
21	IIMR LM - 5004	43.68(41.37) d	S	1642.86
22	TNPSU 241	48.85(44.34) c	S	1320.51
23	VS 43	27.20(31.44) e	MR	2250.39
24	IIMR LM-R23-4507	32.49(34.75) e	S	1854.75
25	WV 146	29.02(32.59) e	MR	2196.87
26	VS 33	24.10(29.40) e	MR	2463.32
27	PPS-98	29.46(32.87) e	MR	1924.98
28	LM NDL 6	20.67(27.04) f	MR	2378.19
	RLM-208 (R)	17.47(24.71) f	MR	2854.96
	RLM-223 (S)	79.20(62.87) a	HS	948.99
	CD ($P \leq 0.05$)	9.50		404.68
	SEm±	3.29		139.93
	CV (%)	11.49		12.28

*BB-Banded Blight

Values in the parenthesis are arc sine transformed values

Values with the same alphabet are statistically not significant

Table 3: Grouping of little millet genotypes based on banded blight severity

S. No	Reaction	Number of Genotypes	Genotypes
1.	Highly Resistance (HR)	-	-
2.	Resistance (R)	-	-
3.	Moderately Resistance (MR)	9	WV 146, VS33, PPS-98, LMNDL-6, VS43, VS 15, WV 295, IIMR-LM-5208, RLM-208
4.	Susceptible (S)	12	IIMR-LM-5007, IIMR LM-8004, TNPSU 244, CLMV-1, WV 297, VS57, VS31, DHLM 311, BLM 19-9E, IIMR LM-5004, TNPSU 241, IIMR LM-R33 4507
5.	Highly Susceptible (HS)	9	OLM-203, BL6, TNPSU 242, DHLM 36-3, JK-8, WV 309, GPUL 16 and OLM 217, RLM-223

Conclusion

The present study highlights the significant challenge posed by Banded Leaf and Sheath Blight (BLSB), caused by *R. solani*, to little millet productivity. Evaluation of 30 little millet genotypes under natural epiphytotic field conditions at the Agricultural Research Station, Vizianagaram, revealed the absence of immune or highly resistant lines, revealing a major limitation in available germplasm resources. However, nine genotypes WV 146, VS 33, PPS-98, LMNDL-6, VS 43, VS 15, WV 295, IIMR- LM-5208, and the resistant check RLM- 208 demonstrated a moderately resistant (MR) disease reaction. Promising entries such as VS 33 (2463.32 kg/ha), LM NDL 6 (2378.19 kg/ha), VS 43 (2250.39 kg/ha), and WV 295 (2207.82 kg/ha), alongside RLM- 208 (2854.96 kg/ha), successfully combined reduced Percent Disease Index (PDI) scores with superior grain yield performance compared to highly susceptible cultivars like RLM-223 (79.20% PDI; 948.99 kg/ha). These identified moderately resistant sources serve as crucial genetic sources and parental lines for resistance breeding studies. By integrating these genetic lines into repeated breeding lines, farmers in rainfed dryland areas can produce high-yielding, BLSB- resistant little millet cultivars. This technique is

cost- effective, sustainable, and environmentally safe reducing disease losses.

Future multi-location evaluations against diverse *R. solani* isolates will be essential to confirm the stability of this resistance across different agro-ecological zones.

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