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Research Article

SCREENING OF LITTLE MILLET (*Panicum miliare* L.) VARIETIES AND GERMPLASMS AGAINST BLAST (*Pyricularia grisea*) AND GRAIN SMUT (*Macalpinomyces sharmae*)

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Abstract: The Little millet *(Panicum miliare* L.) is an important cereal crop in hilly area of south Gujarat. The crop is particularly grown as a one of major cereal crop in The Dang district of south Gujarat. The crop is having its own significance as it is grown organically in this region with not much more use of agrochemicals. More over to this it possess fair levels of protein (22.50%), fat (27.50%), dietary fiber (30.00%) and calcium (0.377%) and thus an important nutraceutical grain for nutrient. Blast (caused by *Pyricularia* spp.) and grain smuts (caused by *Macalpinomyces sharmae*) are the common endemic diseases occurred on this crop and are regarded as one of the main constraints in high and quality yield production. The work on the screening of the varieties released and promising germplasms against major diseases is still lacking in the area. Thus keeping these points in view the present investigation will be taken up to screen different varieties and germplasms against blast and other diseases. Overall results of reaction against leaf, neck and panicle blast under natural condition revealed that out of seventeen genotypes or varieties screened against all the three stages of blast, nine entries *viz*., WV-124, WV-126, WV-130, WV-143, WV-145, WV-146, WV-151, GV-2 and GNV-3 showed resistant reaction while six entries *viz*., TNPSU- 163, TNPSU-171 TNPSU-174, GV-1, OLM-203, CO-2 and JK-8 exhibited moderately susceptible reaction, whereas, one genotypes WV-207 showed susceptible reaction to leaf blast disease. In case of neck blast all the entries screened showed resistant reaction except WV-207 showed moderately resistance reaction. None of entry was found susceptible to panicle blast as it was not observed and recorded from the last four year and thus regarded as highly resistant. The reaction of correlation studies between grain yield, fodder yield, plant height, numbers of tillers per plant and panicle length was found negative against leaf blast except maturity days where as correlation between grain yield, fodder yield, plant height, panicle length and maturity days was found positive against neck blast except number of tillers per plant. All the characters showed non-significant reaction against leaf as well as neck blast. Out of seventeen genotypes and or varieties screened against grain smut one entry *viz*., OLM-203 showed highly resistant reaction while twelve entries *viz*., WV-124, WV-126, WV-130, WV-143, WV-145, WV-146, WV-151, wv-207, GV-1, GV-2, GNV-3 and CO-2 showed resistant reaction. Three entries *viz*., TNPSU167, TNPSU-171 and TNPSU-174 exhibited susceptible reaction. Highly susceptible reaction was exhibited by the variety JK-8. The reaction of correlation studies between grain yield, fodder yield, plant height and maturity days was found highly significant and negatively correlated with grain smut severity index whereas numbers of tillers per plant and panicle length were found non-significant and showed positive and negative correlation against grain smut respectively.

Keywords: *Little millet, Screening, Blast, Grain Smut*

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Introduction

Little millet (*Panicum miliare* L.) is an important cereal crop in hilly area of south Gujarat. The crop is particularly grown as a one of major cereal crop in Dang district of south Gujarat. The crop is having its own significance as it is grown organically in this region with not much more use of agrochemicals. More over to this it possesses fair levels of protein (22.50%), fat (27.50%), dietary fiber (30.00%) and calcium (0.38%) and thus an important nutraceutical grain for nutrient Sood and Sharada (2002) [1]. Blast (*Pyricularia grisea*) and grain smuts (*Macalpinomyces sharmae*) are the common endemic diseases occurred on this crop and are regarded as one of the main constraints in high and quality yield production and these are the common endemic disease occurred on this crop and is regarded as one of the main constraints in high and quality yield production. The work on the screening of the varieties released and promising germplasms against major diseases is still lacking in the area. Thus, keeping these points in view, the present investigation was carried out to screen different varieties and germplasms against blast and grain smut at Hill Millet Research Station, N.A.U., Waghai, Dang of South Gujarat heavy rainfall zone – I and situation – I during *Kharif*-2016 to *Kharif*-2019

Materials and Methods

Seventeen test little millet varieties and promising germplasms were selected to screen. Among them eight promising lines *viz*., WV-124, WV-126, WV-130, WV-143, WV-145, WV-146, WV-151 and WV-207 which were found superior over large scale varietal trial at HMRS, NAU, Waghai. Three promising lines of Coimbatore *viz*., TNPSU 163, TNPSU 171 and TNPSU 176. Three local check varieties *viz*., GV-1, GV-2 and GNV-3and three national check varieties *viz*., OLM203, CO-2 and JK-8 were taken for screening. Plot size: Gross:1.8 x 3 m (Six rows) Net:1.20 x 2.7 m (Four rows) Spacing: 30cm x 10cm. Three replication of each treatment was maintained with application of recommended dose of NPK-40:20:00 kg/ha. Observations on per cent leaf blast intensity, per cent neck blast incidence, per cent panicle blast incidence, grain smut incidence, grain smut severity, grain smut index.

Different morphological characters *viz*., Plant height (cm), numbers of tillers per plant, panicle length (cm), maturity days, grain yield (kg/ha) and fodder yield (kg/ha) were recorded.

Observation of little millet blast

Ten plants randomly selected along with three leaves each from upper, middle, and lower region in individual plot of each replication and the observation on the leaf blast will be taken. In case of neck blast and panicle blast 1 sq. m. area of each plot was selected in center and all the plants were used to record neck blast and panicle blast incidence. All the observations will be taken at dough stage of the crop.

For assessing per cent leaf blast following standard grading system (0-5 scale) was adopted on the basis of percentage leaf area affected Grade 0-No symptoms on the leaves, 1- Small brown specks of pinhead size to slightly elongate, necrotic gray spots with a brown margin, less than 1% leaf area affected, 2- A typical blast lesion elliptical , 5-10mm long, 1-5% of leaf area affected, 3- A typical blast lesion elliptical , 1-2cmm long, 5-25% of leaf area affected, 4-25-50% of leaf area affected, 5- More than 50% of leaf area affected with coalescence of the lesion.

Following standard formulae were used to calculate

Percent Leaf blast = (Σ all the ratings of disease on observed leaves) / (Maximum rating x no. of leaves observed) X 100

Percent neck blast= (No. of ears showing infection per peduncle or neck) / (Total numbers of ears in unit area) X 100

Percent panicle blast = No. of infected panicle per unit area) / (Number of panicles in five plants x total no. of ears observed) X 100

Resistance reaction of the varieties was assessed using the rating for leaf blast

Rank	PDI	Reaction	Grade
0	0	Immune	I
1	0.1-2.00	Highly resistant	HR
2	2.01-10.0	Resistant	R
3	10.01-25.00	Moderately Resistant	MR/MS
4	25.01-50.0	Susceptible	S
5	>50.0	Highly Susceptible	HS

Rresistance reaction of the varieties was assessed using following rating for neck/ panicle blast

Rank	PDI	Reaction	Grade
1	1	Highly resistant	I/HR
2	2.0-10.00	Resistant	R
3	11.0-20.0	Moderately Resistant	MR
4	21.0-30.00	Susceptible	S
5	>30.0	Highly Susceptible	S

Observation of little millet grain smut

Grain smut incidence (%) and severity (%) were recorded at dough stage. 5 rows, ten plants / row and 10 panicles/ row were observed for the disease infection

Susceptibility index (SI) was calculated using the following formula.

Grain smut incidence (%) = (Total smutted plants in one row /Total plants in one row) x 100

Grain smut Severity (%) = (Total smutted grains per panicle / Total grains per panicle) x 100

Susceptibility index (SI) = Grain smut incidence (%) x Grain smut Severity (%)

The little millet entries were grouped into different categories of resistance and susceptibility against grain smut using following scale Nagaraja, *et al*., (2007) [2].

Grain smut Susceptibility index(SI)	Reaction
0	Highly resistant (HR)
Up to 5	Resistant (R)
5.1 to 10.0	Moderately resistant (MR)
10.0 to 15	Susceptible (S)
> 15	Highly susceptible (HS)

Results and discussion

Blast disease

Overall results [Table-1] of reaction against leaf, neck and panicle blast under natural condition revealed that out of seventeen genotypes and or varieties screened against all the three stages of blast nine entries *viz*., WV-124, WV-126, WV-130, WV-143, WV-145, WV-146, WV-151, GV-2 and GNV-3 showed resistant reaction while six entries *viz*., TNPSU- 163, TNPSU-171 TNPSU-174, GV-1, OLM-203, CO-2 and JK-8 exhibited moderately susceptible reaction, whereas, one genotypes WV-207 showed susceptible reaction to leaf blast disease. In case of neck blast all the entries screened showed resistant reaction except WV-207 showed moderately resistance reaction. None of entry was found susceptible to panicle blast as it was not observed and recorded from the last four year and thus regarded as highly resistant.

Grain smut disease

Overall results [Table-2] of reaction against grain smut disease under natural condition revealed that out of seventeen genotypes and or varieties screened against grain smut one entry *viz*., OLM-203 showed highly resistant reaction while twelve entries *viz*., WV-124, WV-126, WV-130, WV-143, WV-145, WV-146, WV-151, wv-207, GV-1, GV-2, GNV-3 and CO-2 showed resistant reaction. Three entries *viz*., TNPSU167, TNPSU-171 and TNPSU-174 exhibited susceptible reaction. Highly susceptible reaction was exhibited by the variety JK-8.

Correlation of grain yield, fodder yield and morphological characters of different germplasm with blast and grain smut

Present study revealed [Table-3, 4] that correlation between grain yield, fodder yield, plant height, numbers of tillers per plant and panicle length was found negative against leaf blast except maturity days where as correlation between grain yield, fodder yield, plant height, panicle length and maturity days was found positive against neck blast except number of tillers per plant. All the characters showed non-significant reaction against leaf as well as neck blast. Grain yield, fodder yield, plant height and maturity days were found highly significant and negatively correlated with grain smut severity index whereas numbers of tillers per plant and panicle length were found non-significant and showed positive and negative correlation against grain smut respectively.

Earlier few studies, for identification of resistant sources against grain smut of little millet were undertaken by Jain, (2002) [3]; Jain, (2003) [4]; Jain *et al*., (2006) [5]; Jain and Tripathi, (2007) [6]; Kumar *et al*., (2017) [7] and reported that little millet variety OLM 203 was resistant while JK 8 was susceptible to grain smut. However, the screening of little millet entries against blast disease was not carried out recently by any workers but it was carried out in other millet crops by several workers *viz*., Sharma *et al*., (2013) [8] in bajra, Kumari, *et al*., (2022) in finger millet [9], Makwana *et al*., (2023) [10] in foxtail millet, the material used and methods adopted in the present experiment was in line with these earlier workers.

Conclusion

Seven little millet germplasms *viz*., WV-124, WV-126, WV-130, WV-143, WV-145, WV-146, WV-151 and two varieties *viz*., GV-2 and GNV-3 were found resistant against blast and grain smut. OLM -203 varieties were found highly resistant to grain smut. Plant breeders are suggested to make use of these lines for further varietal development programme of disease resistance in little millet crop.

Application of research: Screening of Little millet (*Panicum miliare* L.) varieties and germplasms against blast and grain smut

Research Category: Plant Pathology, Disease resistance

Abbreviations

WV- Waghai Vari
GV- Gujarat Vari
DR- Disease Reaction
FR- Final reaction of disease

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Table-1 Screening of Little millet germplasms or varieties against blast disease

Sr. No.	Entry	Leaf blast Intensity (%)									Neck blast incidence (%)									Panicle blast incidence (%)		Final Reaction		
		2016	DR*	2017	DR	2018	DR	2019	DR	FR**	2016	DR	2017	DR	2018	DR	2019	DR	FR	2016-19	DR	Leaf blast	Neck blast	Panicle blast
1	WV-124	8.44	R	9.33	R	7.56	R	9.33	R	R	4.44	R	4.67	R	4.67	R	4.67	R	R	0	HR	R	R	HR
2	WV-126	7.78	R	8.67	R	8.44	R	9.11	R	R	3.33	R	4.22	R	5.56	R	3.33	R	R	0	HR	R	R	HR
3	WV-130	6.89	R	7.56	R	7.78	R	7.56	R	R	3.33	R	4.00	R	4.00	R	2.67	R	R	0	HR	R	R	HR
4	WV-143	9.11	R	7.56	R	9.11	R	7.56	R	R	4.44	R	5.33	R	4.44	R	4.67	R	R	0	HR	R	R	HR
5	WV-145	9.11	R	9.56	R	7.78	R	9.56	R	R	5.56	R	5.78	R	3.33	R	4.67	R	R	0	HR	R	R	HR
6	WV-146	9.33	R	10.22	R	10.00	R	10.22	R	R	3.33	R	3.78	R	3.78	R	3.33	R	R	0	HR	R	R	HR
7	WV-151	7.78	R	8.89	R	8.44	R	9.33	R	R	4.44	R	4.22	R	7.22	R	4.00	R	R	0	HR	R	R	HR
8	WV-207	19.78	MS	25.33	S	19.78	MS	28.44	S	S	6.67	R	15.78	MR	6.67	R	16.00	MR	MR	0	HR	S	MR	HR
9	TNPSU167	10.67	MS	12.00	MS	10.44	R	11.78	MS	MS	4.44	R	4.89	R	4.67	R	4.00	R	R	0	HR	MS	R	HR
10	TNPSU171	11.33	MS	13.56	MS	11.33	R	13.33	MS	MS	3.33	R	4.22	R	4.00	R	2.67	R	R	0	HR	MS	R	HR
11	TNPSU174	10.44	MS	12.44	MS	10.44	R	11.78	MS	MS	3.33	R	4.00	R	4.44	R	3.33	R	R	0	HR	MS	R	HR
12	GV-1	10.44	MS	11.11	MS	10.22	R	11.33	MS	MS	6.67	R	7.33	R	5.56	R	6.89	R	R	0	HR	MS	R	HR
13	GV-2	7.56	R	8.00	R	9.11	R	8.44	R	R	3.33	R	4.00	R	3.33	R	3.78	R	R	0	HR	R	R	HR
14	GNV-3	7.78	R	8.67	R	7.78	R	8.89	R	R	3.33	R	3.33	R	3.33	R	3.11	R	R	0	HR	R	R	HR
15	OLM203	10.22	MS	12.67	MS	12.00	R	12.22	MS	MS	4.44	R	5.11	R	5.56	R	5.33	R	R	0	HR	MS	R	HR
16	CO-2	10.22	MS	12.00	MS	10.22	R	12.00	MS	MS	4.44	R	4.89	R	4.67	R	4.67	R	R	0	HR	MS	R	HR
17	JK-8	10.00	MS	11.78	MS	10.44	R	12.67	MS	MS	3.33	R	4.22	R	4.67	R	4.00	R	R	0	HR	MS	R	HR

Table-2 Screening of Little millet germplasms or varieties against grain smut

Sr. No.	Entry	Grain smut incidence (%)				Grain smut severity (%)				Grain smut severity index (%)								
		2016	2017	2018	2019	2016	2017	2018	2019	2016	DR	2017	DR	2018	DR	2019	DR	FR
1	WV-124	0.67	0.00	0.67	0.00	0.43	0.00	0.00	0.00	0.53	R	0.00	HR	0.00	HR	0.00	HR	R
2	WV-126	0.00	0.00	1.33	0.00	0.00	0.00	0.71	0.00	0.00	HR	0.00	HR	0.98	R	0.00	HR	R
3	WV-130	0.00	1.33	1.33	0.67	0.00	0.71	0.86	0.86	0.00	HR	0.98	R	1.07	R	0.76	R	R
4	WV-143	0.00	0.67	1.33	0.67	0.00	0.29	0.43	0.43	0.00	HR	0.44	R	0.76	R	0.53	R	R
5	WV-145	0.00	0.67	1.33	0.67	0.00	0.29	0.43	0.43	0.00	HR	0.44	R	0.76	R	0.53	R	R
6	WV-146	0.00	1.33	1.33	0.67	0.00	0.71	0.86	0.86	0.00	HR	0.98	R	1.07	R	0.76	R	R
7	WV-151	0.00	0.67	0.67	0.67	0.00	0.29	0.43	0.43	0.00	HR	0.44	R	0.53	R	0.53	R	R
8	WV-207	0.00	0.67	1.33	0.00	0.00	0.29	0.43	0.43	0.00	HR	0.44	R	0.76	R	0.00	R	R
9	TNPSU 167	23.33	24.00	20.67	20.00	5.00	5.00	5.00	5.60	10.80	S	10.95	S	10.17	S	10.58	S	S
10	TNPSU 171	18.00	20.00	21.33	16.67	7.00	7.00	5.00	8.40	11.22	S	11.83	S	10.33	S	11.83	S	S
11	TNPSU 174	26.67	28.00	32.00	25.33	7.00	6.00	6.40	6.00	13.66	S	12.96	S	14.31	S	12.33	S	S
12	GV-1	0.67	1.33	1.33	0.67	0.29	0.71	0.86	0.86	0.44	R	0.98	R	1.07	R	0.76	R	R
13	GV-2	0.67	0.67	1.33	1.33	0.43	0.29	0.43	0.43	0.53	R	0.44	R	0.76	R	0.76	R	R
14	GNV-3	2.00	2.67	2.67	2.00	1.00	1.29	1.71	1.71	1.41	R	1.85	R	2.14	R	1.85	R	R
15	OLM203	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HR	0.00	HR	0.00	HR	0.00	HR	HR
16	CO-2	1.33	0.67	1.33	2.00	0.71	0.50	0.75	0.75	0.98	R	0.58	R	1.00	R	1.22	R	R
17	JK-8	26.67	30.00	33.33	33.33	6.43	8.75	7.50	7.75	13.09	S	16.20	HS	15.81	HS	16.07	HS	HS

Table-3 Morphological characters and grain, fodder yield of different germplasms of little millet over four years (2016-2019)

Sr. No.	Entry	Grain Yield (kg/ha)	Fodder yield (Kg/ha)	Plant height (cm)	No. of tillers/plant	panicle length (cm)	Maturity days
1	WV-124	3342	12459	169.84	5.68	32.92	140
2	WV-126	3177	12428	170.73	5.73	32.99	139
3	WV-130	3268	13114	173.85	7.78	34.17	135
4	WV-143	911	5055	146.33	7.11	32.73	111
5	WV-145	884	7038	153.67	7.3.0	38.00	114
6	WV-146	2782	12474	173.70	7.26	37.48	139
7	WV-151	2996	11854	174.18	7.32	37.53	139
8	WV-207	2608	10094	158.10	6.19	35.18	146
9	TNPSU 167	716	4315	147.03	7.33	33.56	114
10	TNPSU 171	939	5218	145.01	6.98	31.5	114
11	TNPSU 174	790	4490	145.37	7.81	32.9	109
12	GV-1	1538	11913	177.58	5.85	32.7	144
13	GV-2	2673	12263	164.87	6.04	33.6	140
14	GNV-3	2963	12855	167.78	7.45	34.17	140
15	OLM203	1914	11534	190.11	8.69	32.07	147
16	CO-2	3014	12296	173.75	7.65	31.1	146
17	JK-8	869	5307	143.52	8.03	33.55	112

Table-4 Correlation between grain yield, fodder yield and morphological characters on leaf, neck blast and grain smut incidence in little millet over four years (2016-2019)

Characters	Grain Yield(kg/ha)	Fodder yield	Plant height (cm)	No. of tillers/plant	Panicle length (cm)	Maturity days
Leaf Blast	-0.12076	-0.17413	-0.17551	-0.08639	-0.02802	0.13243
Neck Blast	0.03407	0.04862	0.0495	-0.31096	0.11549	0.32464
Grain smut	-0.66799**	-0.76459**	-0.72275**	0.34329	-0.26613	-0.73392**

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Cultivar / Variety / Breed name: Little Millet (*Panicum miliare* L.) Varieties

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