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Screening of Finger Millet Germplasm leading to Identification of Sources of Resistance against Blast, Foot Rot and Brown Spot Diseases under Natural Field Conditions

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A B S T R A C T

A total of thirty three finger millet genotypes were screened to identify the sources of resistance against blast, foot rot and brown spot diseases at Centre for Pulses Research (CPR), Berhampur, Odisha during *Kharif* 2017 under natural field condition. Among 33 genotypes evaluated, none of the genotypes were found resistant for blast disease as well as for brown spot disease however only VR 1101 expressed as moderately resistant for leaf blast. For neck blast the disease incidence ranged from 17.8 % (PR 1511) to 66.0 % (PRS 38) where as it was 19.7 % (GPU 96) to 67.6 % (TNEC 1292) in case of finger blast as compared to 97.0 % (neck blast) and 98.8 % (finger blast) infection, respectively in susceptible check VR 708. In case of for foot rot disease, resistance was observed in nine genotypes namely WN 585, OEB 601, VR 1101, PR 1511, OEB 602, VL 389, GMB, VL 352 and PR 202. Our research findings led to identification of two genotypes namely VL 389 and GPU 96 out of thirty three genotypes as resistant to three major diseases i.e. blast, foot rot and brown spot.

Introduction

Once upon a time millets were neglected & underutilized and thus they were called as orphan crops. However, because of renewed attention for healthier foods in recent times, millets have gained importance among all stakeholders including policy makers. In an era of climate change and prevalence of dietary induced malnutrition the importance of millet crops is enhanced due to their stress adaptability, multifarious use and nutritive values. Almost 95% of global acreage of millet lies in the developing countries, mainly in Africa and Asia (http://www.millets.res.in/vision/vision2050). Finger millet (*Eleusine coracana* L.) is more commonly known as *ragi* or *mandua* is an important millet crop grown extensively in various parts of India and Africa (Devi *et al.*, 2014). Finger millet constitutes the bulk of small millet production in India to the tune of 80% of total minor millet production in the country (Anonymous, 2015). In nutritional terms millets are no lesser than popular cereals (Devi *et al.*, 2014). In fact because of it being as one of the most nutritious among all major cereals Finger millet has been perceived as "super cereal" by United States National Academies. Finger millet is rich in minerals and high in micronutrient density (Kumar *et al.,* 2016). It is a very good source of health benefitting nutrients *viz.* calcium (0.38%), protein (6%–13%), dietary fiber (18%), carbohydrates (65%–75%), minerals (2.5%–3.5%), phytates (0.48%), tannins (0.61%), phenolic compounds (0.3–3%). In addition to these components, finger millet is also a good source of vitamins, essential amino acids and trypsin inhibitory factors. Because of these nutrients together the crop renders many health beneficial properties such as anti-diabetic, antitumerogenic, anti-diarrheal, anti-inflammatory, antiulcer, atherosclerogenic effects, antioxidant and antimicrobial properties to the users (Chandra *et al.*, 2016; Bal *et al.*, 2020).

Production of finger millet is being limited by many diseases. In India production of finger millet is being mainly affected by blast, foot rot, and brown spot diseases (Nagaraja *et al.,* 2007; Bal *et al.*, 2020). Depending upon the severity blast disease can cause loss to the tune 50 – 90 % whereas other two diseases i.e. foot rot and brown spot diseases cause considerable losses to the crop (Rao, 1990; Esele, 2002; Bal *et al.*, 2020). Looking for region specific resistant varieties and their incorporation in the cropping system is ecologically sustainable, economical, efficient and thus most suitable approach for managing the diseases. Under this study, an attempt has been taken to identify the sources of resistance against these diseases at natural field conditions of south eastern coastal plain zone of Odisha.

Materials and Methods

Field trials were conducted to evaluate thirty three finger millet genotypes comprising of IVT and AVT materials against three major diseases at Centre for Pulses Research, OUAT, Berhampur during *Kharif* 2017. Each genotype was sown in two rows of 3m length and both the rows were sandwiched on either side with a susceptible check viz., VR 708 with row to row spacing and plant to plant spacing of 22.5 x 10 cm and the pattern were followed in three replications. Along with favourable climate for disease expression during *Kharif* season, an additional effort was made wherein leaves infected by blast disease were plucked and chopped into small bits (having symptomatic parts bearing the spores of the pathogen) and a suspension was made and sprinkled on the test varieties during evening hours when environmental conditions use to be favourable for disease expression viz., temperature around 26-30 ºC and humidity over 90%. It was done thrice, first time during seedling stage and twice during heading stage. All the recommended agronomic practices were attended except fungicidal and insecticidal spray. For recording the observations, five randomly selected plants were taken from each genotype/replication following Standard Evaluation Systems (SES) scale for different diseases provided by AICRP (All India Coordinated Research Project) on Small millets presented below. Blast disease was screened at three phases of the crop i.e. at seedling stage (35-40 days old plant) for leaf blast and at dough stage (70-75 days old plant) for neck and finger blast (Table 1–4).

$$\text{Neck blast (\%)} = \frac{\text{No. of infected panicles}}{\text{Total no. of panicles}} \times 100$$

$$\text{Finger blast (\%)} = \frac{\text{No. of infected fingers}}{\text{Average number of fingers} \times \text{Total Number of panicles}} \times 100$$

Results and Discussion

Blast disease

When plants were at vegetative stage, around 35-40 days old, they were screened for leaf blast disease. Among 33 genotypes evaluated, none of the genotypes exhibited resistance reaction, however only one genotype i.e. VR 1101 showed moderately resistance reaction, 24 genotypes were observed to be susceptible and 8 genotypes to be highly susceptible against leaf blast. When plants were of 70-75 days old, they were again observed for incidence of neck blast disease. The disease incidence ranged from 17.8 % to 66.0 % indicating that none of the genotypes showed resistance against neck blast. Six genotypes (*viz*. OEB 601, PR 1511, WN 559, OEB 602, L 389 and GPU 96) were found to be moderately resistant and the remaining test entries were noted to be either susceptible or highly susceptible against neck blast (Table 5). When plants began maturing, they were screened for finger blast disease where none of the genotypes were found to be resistant against the disease and the percentage of infection ranged from 19.7 % to 67.6 % compared to 98.8 % in susceptible check (VR 708). Moderate resistance was observed in case of five genotypes *viz.* KMR 633, VL 389, GPU 97, GPU 96 and PR 10-35. Out of 33 genotypes, a total of 22 numbers of genotypes showed susceptible reaction where as 6 numbers of genotypes exhibited highly susceptible reaction against finger blast disease.

At three phases of blast diseases evaluation, none of the genotypes were observed to be either immune or resistant for three types of blast i.e. leaf blast, neck blast and finger blast. From leaf blast screening, it was evident that except VR 1101, the remaining 32 genotypes were noted to be either susceptible or highly susceptible but at later stages of evaluation they could show moderately resistance reaction. Hence in our study no such relationship could be found among leaf blast, neck blast and finger blast disease. Esele *et al.,* (2002) explained that prevailing weather conditions at a particular stage of crop growth might determine the intensity of blast infection. Bal *et al.,* (2020) screened eighteen genotypes under field conditions during *Kharif* 2016, out of which eight genotypes namely GPU 67, BR 14-3, L 352, KOPN 942, PR 202, VR 708, PR 10-35 and GPU 45 are common in the present study and these genotypes manifested similar reaction against finger blast and neck blast. In the present investigation only two genotypes i.e. VL 389 and GPU 96 showed moderately resistance reaction for both neck blast and finger blast. Patro *et al.,* (2018) screened 30 finger millet genotypes under natural field conditions and found GPU 97 as susceptible and GPU 45 as highly susceptible against neck blast. As far as host response against finger blast is concerned, genotypes KOPN 1059, GPU 67, VL 390 and KWFM 49 exhibited susceptible reaction whereas germplasm RAuF 15, IIMR FM 6655, PRS 38, TNEC 1292 and TNEC 1294 showed highly susceptible reaction. Findings of Patro *et al.,* (2018) are in consonance with our research findings. In eastern coastal zone Odisha, genotype PR 202 has been showing highly susceptible reaction for leaf blast, neck blast and finger blast (Table 5) but Kiran Babu (2013) reported it to be a resistant line as the level of infection was less than 10% under natural field condition at Patancheru, Hyderabad in the year 2009. Kumar *et al.,* (2006) rated genotype PR 202 as highly susceptible in the Karnataka State where as in Jharkhand the same genotype (i.e. PR 202) has been evaluated as moderately resistant by Barnwal (2012). These studies prove the spatial variability of genotype PR 202 as far as its response to blast disease is concerned.

Table.1 Standard Evaluation System (SES) scale for leaf blast disease

Score	Description	Reaction
0	No lesions/symptoms on leaves	Immune
1	Small brown specks of pinhead to slightly elongated, necrotic grey spots with a brown margin, less than 1% area affected	HR
2	A typical blast lesion elliptical, 5-10 mm long,1-5% of leaf area affected	R
3	A typical blast lesion elliptical, 1-2 cm long, 6-25% of leaf area affected	MR/MS
4	26-50 % of leaf area affected	S
5	More than 50 % of leaf area affected with coalescing lesions	HS

Table.2 Score chart for Neck Blast (NB) and Finger Blast (FB)

Score	Description	Reaction
0	No incidence	Immune
1	Less than 5%	HR
2	5-10%	R
3	11-25%	MR/MS
4	26-50%	S
5	More than 50%	HS

Table.3 Standard Evaluation System (SES) scale for brown spot disease

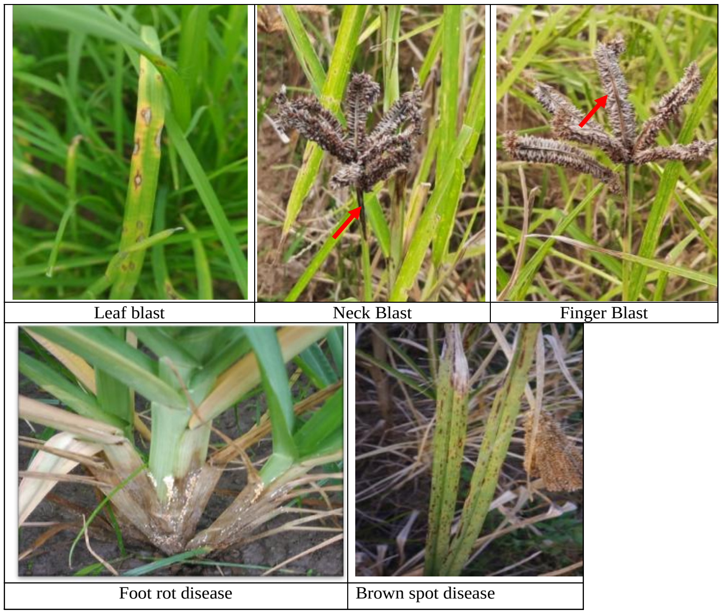
Score	Description	Reaction
0	No incidence	Immune (I)
1	Less than 1% leaf area affected	HR
2	1-5% leaf area affected	R
3	6-25% leaf area affected	MR/MS
4	26-50% leaf area affected	S
5	More than 50% leaf area affected	HS

Table.4 Standard Evaluation System (SES) scale for foot rot disease

Score	Description	Reaction
1	0 % (no disease)	Immune (I)
2	Up to 1%	HR
3	2-10%	R
4	11-20%	MR
5	21-50%	S
6	More than 50%	HS

Table.5 Disease response of finger millet genotypes against major diseases under natural field condition during *Kharif* 2017

Sl No.		**Blast disease**						**Foot rot disease**	**Disease reaction**	**Brown spot disease**	**Disease reaction**
		Leaf blast	Disease reaction	Neck blast	Disease reaction	Finger blast	Disease reaction				
1.	PR 1507	5.0	HS	41.1	S	38.3	S	21.6	S	3.6	MR
2.	WN 550	4.3	S	26.3	S	40.0	S	12.7	MR	4.3	S
3.	WN 585	4.3	S	39.1	S	48.9	S	9.9	R	3.3	MR
4.	OEB 601	4.3	S	22.5	MR	36.2	S	9.7	R	3.0	MR
5.	VR 1101	3.6	MR	37.2	S	41.5	S	9.4	R	5.0	HS
6.	PR 1511	4.6	S	17.8	MR	29.9	S	6.0	R	4.6	S
7.	WN 559	4.3	S	21.7	MR	29.1	S	12.2	MR	3.3	MR
8.	OEB 602	4.0	S	22.3	MR	28.1	S	6.5	R	3.3	MR
9.	RAuF 15	4.6	S	56.1	HS	57.9	HS	13.8	MR	3.0	MR
10.	ML 181	4.6	S	37.5	S	23.9	S	13.3	MR	5.0	HS
11.	VL 390	4.6	S	49.1	S	40.3	S	22.2	S	5.0	HS
12.	IIMR FM 6655	5.3	HS	61.2	HS	54.1	HS	27.7	S	5.0	HS
13.	KMR 633	4.6	S	32.7	S	21.9	MR	32.7	S	3.6	MR
14.	KWFM 49	4.3	S	42.0	S	46.3	S	33.1	S	4.6	S
15.	RAuF 13	4.0	S	45.3	S	39.5	S	13.8	MR	5.0	HS
16.	ML 322	4.0	S	59.6	HS	34.7	S	11.0	MR	5.0	HS
17.	VL 389	4.0	S	21.2	MR	20.2	MR	4.9	R	3.3	MR
18.	PRS 38	5.0	HS	66.0	HS	66.2	HS	27.2	S	3.3	MR
19.	KMR 632	5.3	HS	26.7	S	42.3	S	28.8	S	3.6	MR
20.	KOPN 1059	4.6	S	37.5	S	45.4	S	17.2	MR	3.0	MR
21.	TNEC 1292	4.3	S	64.8	HS	67.6	HS	16.3	MR	3.3	MR
22.	GPU 97	4.3	S	30.5	S	22.1	MR	14.9	MR	5.0	HS
23.	TNEC 1294	4.3	S	59.2	HS	55.6	HS	41.6	S	3.3	MR
24.	GPU 96	4.3	S	18.6	MR	19.7	MR	17.1	MR	3.0	MR
25.	GMB	5.3	HS	29.6	S	26.8	S	6.0	R	4.3	S
26.	VL 386	5.3	HS	45.4	S	46.6	S	17.7	MR	5.0	HS
27.	BR 14-3	4.3	S	26.5	S	33.1	S	13.3	MR	4.6	S
28.	PR 10-35	5.0	HS	39.0	S	23.5	MR	24.9	S	4.6	S
29.	KOPN 942	4.3	S	43.4	S	44.1	S	11.6	MR	4.0	S
30.	GPU 45	4.3	S	51.3	HS	34.9	S	12.4	MR	5.0	HS
31.	VL 352	4.6	S	27.9	S	26.9	S	8.2	R	4.0	S
32.	GPU 67	4.6	S	53.5	HS	29.5	S	34.3	S	5.0	HS
33.	PR 202	5.3	HS	55.7	HS	50.5	HS	10.0	R	5.0	HS
Check	VR 708	5.3	HS	97.0	HS	98.8	HS	28.4	S	4.0	S



Leaf blast | Neck Blast | Finger Blast
Foot rot disease | Brown spot disease

In simple words it can be said that genotype PR 202 exhibits resistance, moderately resistance and highly susceptible reactions in various geographical regions of India.

Foot rot disease

The disease symptoms could be noticed at 25-30 days after transplanting and the genotypes were evaluated based on the level of symptoms. The percentage infection ranged from 4.9 % (VL 389) to 41.6 % (TNEC 1294). Nine genotypes were found to be resistant, fourteen as moderately resistant, ten genotypes as susceptible whereas none of the genotype was rated as highly susceptible against the foot rot disease. The genotypes observed to be resistant were WN 585, OEB 601, VR 1101, PR 1511, OEB 602, VL 389, GMB, VL 352 and PR 202 whereas genotypes WN 550, WN 559, RAuF 15, ML 181, RAuF 13, ML 322, KOPN 1059, TNEC 1292, GPU 97, GPU 96, VL 386, BR 14-3, KOPN 942 and GPU 45 exhibited moderately resistance reaction. Madhukarrao (2013) screened 14 genotypes of finger millet against the foot rot disease wherein genotypes PR 202 and VL149 were found to be moderately resistant, genotype GN-4 exhibited highly susceptible reaction and remaining genotypes were tested to be susceptible.

Brown spot disease

In case of brown spot disease, resistance could not be seen in any of the test materials however fourteen genotypes (*viz*. PR 1507, WN 585, OEB 601, WN 559, OEB 602, RAuF 15, KMR 633, VL 389, PRS 38, KMR 632, KOPN 1059, TNEC 1292, TNEC 1294 and GPU 96) exhibited moderately resistance reaction against the disease. Eight and eleven numbers of genotypes appeared as susceptible and highly susceptible, respectively. Kiran Kumar, (2011) tested 65 genotypes of finger millet against brown spot disease, out of which 30 were found as immune, 24 as highly resistant, 6 as resistant and the remaining 5 as moderately resistant against the brown spot disease.

From our present study, VL 389 was found to be moderately resistant against neck blast, finger blast, and brown spot diseases. It was also noted to be resistant to foot rot disease. Similarly, genotype GPU 96 was found to be moderately resistant against neck blast, finger blast, foot rot and brown spot disease. Hence, out of thirty three genotypes tested two genotypes *viz.* VL 389 and GPU 96 can be categorized as multiple disease resistant genotypes. These promising genotypes can be used in breeding programmes and the genotypes showing susceptible to highly susceptible reactions can also be utilized in developing recombinant inbred lines for finger millets which in turn will lead to advancement of finger millet lines using molecular means.

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References

Bal, S.S., Kumar, S., Mishra, I.O.P., Mohapatra, P.M., Panigrahi, R.K., Panda, P.K. 2020. Evaluation of finger millet genotypes against three major diseases in east and south eastern coastal plain zone of Odisha. Journal of pharmacognosy and phytochemistry. 9(3):635-638.

Barnwal, M.K. 2012. Evaluation of finger millet varieties against blast (*Pyricularia grisea*) under rainfed conditions. J Mycol. Pl. Pathol. 42(2):222-224.

Chandra, D., Chandra, S., Pallavi, Sharma, A.K. 2016. Review of Fingermillet (*Eleusine coracana* (L.) Gaertn):A powerhouse of health benefiting nutrients. Food Science and Human Wellness.5: 149–155.

Devi, P.B., Vijayabharati, R., Sathyabama, S., Malleshi, N.G. and Priyadarsini, V.B. 2014. Health benefits of finger millet(*Eleusine coracana* L.) polyphenols and dietary fiber:a review. Journal of Food Sci. Technology. 51: 1021-1040.

Esele, J.P.E. 2002. Disease of Finger millet – A global review. In: John F. Leslie (ed) -*Sorghum and millets diseases*, Iowa state press, Iowa, USA.

Kiran Babu, T.2013. Epidemiology, Virulence Diversity and Host-Plant Resistance in Blast [*Magnaporthe grisea* (Hebert) Barr.] of Finger Millet [*Eleusine coracana* (L.) Gaertn.]. Hyderabad, India. M. Sc. (Agri.) Thesis, Dept. of Plant Pathology, Acharya N. G. Ranga Agricultural University, Rajendranagar, India.

Kiran Kumar, A.C. 2011. Studies on brown leaf spot disease (*Helminthosporium spp.*) of finger millet and foxtail millet. Bengaluru, India. M. Sc. (Agri.) Thesis, Dept. of Plant Pathology, University of Agricultural Science, Bengaluru, India.

Kumar, A., Metwal, M., Kaur, S., Gupta, A.K., Puranik, S., Singh, S., Singh, M., Gupta, S., Babu, B.K., Sood, S. and Yadav, R. 2016. Nutraceutical Value of Finger Millet [Eleusine coracana (L.) Gaertn.], and Their Improvement Using Omics Approaches. Front. Plant Sci. 7:934.

Kumar, V.B.S., Kumar, T.B.A and Nagaraju. 2006. Anatomical defense mechanism in finger millet leaves against blast caused by *Pyricularia grisea* Sacc. Mysore Journal of Agricultural Sciences. 40(1): 27-30.

Madhukarrao, P.D. 2013. Management of foot rot (*Sclerotium rolfsii* Sacc.) of finger millet (*Eleusine coracana* L. Gaertn). Gujarat, India. M. Sc. (Agri.) Thesis, Dept. of Plant Pathology, N.M. College of Agriculture, N.A.U.,

Navsari, India.
Nagaraja, A., Jagadish, P.S., Ashok, E.G., Krishne., Gowda, K.T.2007. Avoidance of finger millet blast by ideal sowing time and assessment of varietal performance under rainfed production situations in Karnataka. Journal of Mycopathological Research.45(2): 237-240.
Patro, T.S.S.K., Meena, A., Divya, M., Anuradha, N.2018. Evaluation of finger millet early and medium duration varieties against major diseases. International Journal of Chemical Studies. 6(3):2184-2186.
Rao, A. 1990. Estimates of losses in finger millet (*Eleusine coracana*) due to blast disease (*Pyricularia grisea*). Mysore J. Agric. Sci. 24: 57–60.

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