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Screening Popular Finger Millet Varieties for Foot Rot Resistance

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Abstract

The present study was undertaken to evaluate reaction of 10 popular finger millet varieties *viz*., Indaf-7, Indaf-9, MR 1, MR 2, GPU 28, GPU 48, GPU 66, GPU 67, KMR 301 and KMR 204 along with susceptible check Indaf-5 during *Kharif* 2015 and 2016. With a mean foot rot incidence ranging from 0.45 to 4.59 and 1.77 to 3.47 per cent at tillering and maturity stage, respectively, six and three varieties were found resistant. The varieties MR 6 and KMR 301were also found to be significantly superior for grain yield of 4135 and 3765 kg ha^{-1} compared to 2165 kg ha^{-1} in the check. It is evident that compared to old varieties the newly released varieties were highly beneficial in terms of highest productivity realization with low foot rot incidence.

Keywords: Foot rot disease, finger millet

Finger millet commonly known as *Ragi* is one of the important food crops and largely grown in southern states of India. It is indispensable to Indian agriculture as a source of grain and straw in a vast dryland area. In India, finger millet has been grown over an area of 12.08 million hectares and production of 20.60 million tons with1706 kg ha^{-1} productivity (Anon., 2014). Major ragi growing states are Karnataka, Maharashtra, Uttarakhand, Tamil Nadu, Odisha, Andhra Pradesh, Gujarat, Jharkhand, West Bengal, Biharand Chattisgarh that account for more than 95 per cent of the area and production of finger millet in the country. In Karnataka, finger millet occupies an area of 7.08 lakh hectare with a production of 12.98 lakh tons and productivity 1833 $kgha^{-1}$ (Anon., 2014) and its cultivation is concentrated mostly in the districts of Bengaluru rural, Tumakuru, Chitradurga, Hassan, Kolar, Ramanagara, Chikkaballapura, Chamarajanagara, Mysuru and Mandya (Ashoka and Halikatti, 1997). Due to its greater tolerance to biotic and abiotic stresses, better suitability for different cropping systems and contingent crop plans; it iscultivated on varied soil and climatic conditions compared to other cereals. Finger millet is commonly called as 'nutri-millet' as the grains are nutritionally superior to many cereals providing fair amount of proteins, minerals, calcium and vitamins in abundance to the people. It is the cheapest and preferred food crop of economically suppressed and physically hard working people. The protein of finger millet has been reported to possess a fairly high biological value, which is needed for the maintenance of nitrogen equilibrium of the body. The higher fiber content of finger millet helps in many ways as it prevents constipation, high cholesterol formation and intestinal cancer. Hence, people suffering from diabetes mellitus are advised to eat millets instead of rice(Malleshi and Hadimani,1993).

The yield potential is low asthe crop is plagued with a number of diseases. Though the crop has been important over centuries, research efforts are more concerted to evolve improved varieties and development of production technology. Among the major diseases, foot rot caused by *Sclerotium rolfsii* Sacc. is one of the important emerging diseases of finger millet and is on the increase in the recent past particularly under irrigated and high rainfall situations (Nagaraja and Anjaneya Reddy, 2009). The disease has been reported to cause more than 50 per cent yield loss (Batsa and Tamang, 1983). The studies on varietal screening for foot rot resistance are rather scanty. Hence, an effort has been made in this study to assess the foot rot resistance in the released varieties of finger millet that are already popular among the farmers.

Material and Methods

The experiment was carried out at the Zonal Agricultural Research Station, VC Farm, Mandya during *Kharif* 2015 and 2016. Finger millet varieties were sown in plots of 3 m × 2.25 m size with a row

length of 5 m. Giant culture of *Sclerotium rolfsii* was applied to make the soil sick in which ten high yielding popular finger millet varieties *viz*., Indaf-7, Indaf-9, MR 1, MR 2, GPU 28, GPU 48, GPU 66, GPU 67, KMR 204 and KMR 301along with a susceptible check Indaf-5 were sown. The foot rot per cent disease incidence was recorded at tillering and maturity stages along with the size of lesion. Per cent disease incidence was calculated as the total number of plants affected out of the total plants. The varieties were categorized based on the per cent foot rot disease incidence as suggested by Basawaraj (2005).

Per cent disease incidence	Category
0	Immune
1-5	Resistant
6-10	Moderately resistant
11-15	Moderately susceptible
16-25	Susceptible
>26	Highly susceptible

Results and Discussion

Collar lesions in different varieties ranged from 3.20 to 23.80 cm with maximum size in the variety KMR 301 followed by Indaf-9 and Indaf-7(23.80, 21.20 and 17.10 cm respectively) during *kharif* 2015. While, least lesion size was recorded in GPU 28 and GPU 66 (3.20 cm) compared to check variety (24.05 cm). At tillering stage least foot rot disease was observed in the varieties GPU 28 (0.13%), GPU 48 (0.65%), GPU 66 (1.59%) and KMR 204 (1.67%); whereas maximum foot rot per cent disease incidence was recorded in Indaf-9 (6.40) compared to check (15.61). At maturity stage, the disease progressed and among the varieties least incidence was recorded in the variety GPU 28 (1.54%) followed by GPU 48 (1.89%) and KMR 204 (2.93%) compared to susceptible check (40.16%). The varieties which recorded less than 5 per cent foot rot disease incidence were rated resistant, besides they have recorded more grain yield ranging from 2819 to 3472 kg ha^{-1} compared to check variety 2331 kg ha^{-1} (Table I, Fig.1).

Table I

Reaction of popular finger millet varieties for foot rot resistance during Kharif 2015

Varieties	Collar lesion size (cm)	Foot rot incidence (%)				Grain yield Kg ha^{-1}
		At tillering stage		At crop maturity		
Indaf-7	17.10	5.44	(13.41)	17.00	(24.28)	2828
Indaf-9	21.20	6.40	(14.57)	12.80	(20.94)	3799
MR 1	6.53	5.48	(13.48)	8.94	(17.39)	3997
MR6	11.86	3.94	(11.43)	13.35	(21.35)	4245
GPU 28	3.20	0.13	(1.18)	1.54	(6.87)	2819
GPU 48	4.20	0.65	(4.61)	1.89	(7.84)	3492
GPU 66	3.20	1.59	(7.13)	5.04	(12.85)	3903
GPU 67	6.33	3.13	(10.13)	5.60	(13.68)	3323
KMR 301	23.80	5.00	(12.87)	9.21	(17.67)	4531
KMR204	3.80	1.67	(7.38)	2.93	(9.76)	3472
Indaf-5	24.00	15.61	(23.06)	40.16	(39.31)	2331
S.Em±		1.2		1.5		235
CD@5%		3.4		4.4		694
CV(%)		18.39		12.90		11.57

*Figures in the parenthesis are arc sin transformed values

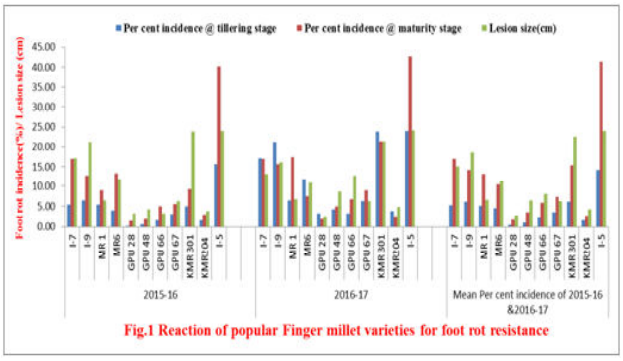

Fig.1 Reaction of popular Finger millet varieties for foot rot resistance

During the year 2016 also, same trend was observed regarding the lesion size, per cent foot rot disease incidence and grain yield, but the disease pressure was low due to unfavorable weather for the development of the pathogen. Least meansize of foot rot lesion ranging from 2.53 (GPU 28) to 6.76 cm (MR 1) was recorded in different varieties whereas, maximum size of 21.40 cm was observed in the variety KMR 301. At tillering stage the least per cent foot rot incidence was recorded in the variety GPU 28 (0.77%) followed by GPU 48 (1.48%) and KMR 204 (1.61%) and were identified as resistant. Further, at maturity stage the highest average foot rot incidence was noticed in the variety KMR 301 (21.43%) followed by MR 1 and Indaf-7 (17.39% and 16.97%) and thus they were moderately susceptible. Least foot rot incidence was recorded in the variety GPU 28 (2.00%) followed by KMR 204 (2.50%) and GPU 48 (5.04%) and thus fell under the resistant group compared to susceptible check with 42.63 per cent disease (Table II, Fig.1).

The pooled results of *Kharif* 2015 and 2016 showed that, the varieties GPU 28 (2.87 cm) and KMR 204 (4.33 cm) recorded the least mean lesion size. However, few varieties *viz*., GPU 28, GPU 48, KMR 204, GPU 66, GPU 67 and MR 6 at tillering, whereas only three varieties GPU 28, GPU 48 and KMR 204 revealed less than 5 per cent foot rot incidence at maturity also. Yield of different varieties ranged from

TABLE II

Reaction of popular finger millet varieties for foot rot resistance during Kharif 2016.

Varieties	Collar lesion (cm)	Foot rot incidence (%)				Grain yield Kg ha^{-1}
		At tillering stage		At crop maturity		
Indaf-7	13.13	5.12	(13.01)	16.97	(24.27)	2529
Indaf-9	16.03	5.82	(13.95)	15.68	(23.26)	2418
MR 1	6.76	4.90	(12.75)	17.39	(24.64)	3080
MR6	10.90	5.23	(13.18)	7.42	(15.76)	3285
GPU 28	2.53	0.77	(5.02)	2.00	(8.00)	2588
GPU 48	8.66	1.48	(6.83)	5.04	(12.90)	3220
GPU 66	12.80	3.04	(9.72)	6.82	(14.80)	2248
GPU 67	6.33	3.80	(11.18)	8.98	(17.41)	3234
KMR 301	21.40	7.23	(15.54)	21.43	(27.53)	3739
KMR204	4.86	1.61	(7.17)	2.50	(8.97)	2478
Indaf-5	24.10	12.68	(20.84)	42.63	(40.72)	1998
S.Em±		0.9		0.9		212
CD@5%		2.8		2.8		626
CV(%)		13.84		9.34		13.12

*Figures in the parenthesis are arc sin transformed values

TABLE III

Two season's data on reaction of finger millet varieties for foot rot resistance

Varieties	Mean Collar lesion (cm)	Foot rot incidence (%)				Grain yield Kg ha^{-1}
		At tillering stage		At crop maturity		
Indaf-7	15.12	5.28	(13.21)	16.98	(24.33)	2679
Indaf-9	18.62	6.11	(14.28)	14.24	(22.14)	3109
MR 1	6.65	5.19	(13.13)	13.17	(21.27)	3538
MR6	11.38	4.59	(12.34)	10.39	(18.77)	3765
GPU 28	2.87	0.45	(3.83)	1.77	(7.63)	2703
GPU 48	6.43	1.07	(5.84)	3.47	(10.71)	3356
GPU 66	8.00	2.31	(8.54)	5.93	(14.02)	3076
GPU 67	6.33	3.47	(10.67)	7.29	(15.65)	3278
KMR 301	22.60	6.12	(14.26)	15.32	(23.02)	4135
KMR204	4.33	1.64	(7.35)	2.72	(9.45)	2975
Indaf-5	24.05	14.14	(22.02)	41.40	(40.04)	2165
S.Em±		0.9		0.8		153.88
CD@5%		2.6		2.4		453.94
CV(%)		13.33		7.47		8.43

*Figures in the parenthesis are arc sin transformed values

TABLE IV

Correlation and Regression between lesion size and foot rot (%)

Source	Lesion size	Foot rot (%)
Lesion size (cm)	1	**
Foot rot (%)	0.857204	1 **

Note: Values followed by ** are statistically significant

Regression Statistics	
Multiple R	0.857204312
R Square	0.734799233
Adjusted R Square	0.705332481
Standard Error	4.937063835
Observations	11

	Coefficients	P - value	Lower 95 %	Upper 95 %
Intercept	6.83652427	0.038560979	0.447978957	13.22506958
Lesion size	1.043109931	0.000745401	0.570574214	1.515645648

2165 to 4135 kg ha^{-1} with the least being in Indaf-5 (check) and highest in KMR 301. The difference in yield levels is attributed to the differential maturity/ duration of the varieties. However, varieties GPU 28 and KMR 204 with resistant reaction to foot rot recorded 2703 and 2975 kg ha^{-1}, respectively, and are of mid late maturity (Table III, Fig. 1). These finding are in agreement with the results of Somashekhara *et al.* (1990;1992), Ashoka *et al.* (1997) and Raveendra *et al.* (2013).

Correlation studies revealed that, the mean lesion size was strongly correlated with the foot rot per cent incidence by the correlation coefficient value of 0.857204 and p value of r0.000745401 (Table IV). Whereas, the foot rot disease at maturity stage perfectly linked with the lesion size of all the varieties. This result indicating that there is a significant correlation between lesion size as well as per cent foot rot for increasing disease severity. Similar reports

have been made in potato by Mejda Daami Remadi *et al*. (2012).

Among the 10 varieties evaluated for foot rot resistance, GPU series were most promising followed by KMR series, but Indaf series were susceptible to foot rot. From this study, few resistant sources of finger millet to foot rot have been identified that can be utilized in breeding foot rot resistant varieties.

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