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RESEARCH ARTICLE

Field screening of germplasm lines and local genotypes against charcoal rot of sorghum caused by *Macrophomina phaseolina* (Tassi.) Goid

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ABSTRACT

Sixty four germplasm lines including local genotypes were screened for charcoal rot resistance in the sickplot during 2006-07 and 2007-08. The results of the study indicated that the genotypes Dagadi Solapur (12.35%), followed by GRS-1 (13.15%), BCR-9 (14.25%) showed less disease incidence compared to other genotypes. Highest per cent charcoal rot incidence was recorded in CSV-8R (56.10%). The study also revealed that the local genotypes recorded reduced levels of other charcoal rot parameters such as per cent lodging due to charcoal rot (soft stalk), mean length of spread (MLS) and mean number of nodes crossed (MNC). The local genotypes also possessed desired breeding traits such as delayed senescence and stay green type which could be employed in resistance breeding programme of *Rabi* sorghum.

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INTRODUCTION

Sorghum [*Sorghum bicolor* (Linn.) Moench] has occupied an area of 92.0 lakh ha. with the production of 82.70 lakh tones and productivity of 615 kg/ha (Biradar *et al*., 2006). Karnataka has an area of 18.91 lakh ha, out of which *Rabi* sorghum is grown in 12.08 lakh ha with a production of 12.14 lakh tones with productivity of 1005 kg/ha (Chari Appaji *et al*., 2009). Nearly 65 per cent of the total area in the state is covered during *Rabi* (post rainy) season on stored moisture which accounts for 44 per cent of total sorghum production. *Rabi* sorghum area is mainly covered by states of Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu and Gujarat. The hunt for new varieties and hybrids with better productivity and resistance is a continuous process in crop improvement. Charcoal rot disease has become a major production constraint in *Rabi* sorghum. The indirect loss

computed due to this disease alone amounts to 40 per cent (Hiremath and Palakshappa, 1994). Patil (1980) reported that the loss in grain yield was more in *Rabi* (40.83%) than in *Kharif* (17.69%). With this background, present investigation was made to collect and screen sixty four genotypes for charcoal rot resistance with good agronomic characters.

MATERIALS AND METHODS

Field experiments were conducted at Regional Agricultural Research Station, Bijapur in sickplot conditions followed by toothpick inoculation during 2005 and 2006. Test genotypes were sown during the second fortnight of October with a spacing of 45cm x15cm with three replications. The susceptible check, CSV-8R was sown after two test entries. Observations on per cent charcoal rot incidence, lodging per cent due to charcoal rot, mean length of spread (cm), mean number of nodes crossed, grain yield, fodder yield and thousand grain weight were recorded for screening purpose.

Based on the percentage lodging and soft stalk, the genotypes were graded using 0-9 scale (Mayee and Datar, 1986) and grouped into respective categories as follows:

Grade	Per cent infection	Reaction
0	0	Immune
1	<1	Highly resistant
3	2-10	Resistant
5	11-25	Moderately resistant
7	26-50	Susceptible
9	51-100	Highly susceptible

RESULTS AND DISCUSSION

The pooled data revealed that, per cent charcoal rot was least in Dagadi Solapur (12.35%), followed by GRS-1 (13.15%), BCR-9 (14.25%). Highest per cent charcoal rot incidence recorded in CSV-8R (56.1). Least per cent lodging was recorded in GRS-1 (18.1) followed by Kadabina jola (18.75), SPV-1588 (21.6), CSV-14R (21.8). Highest per cent lodging was recorded in CSV-8R (55.8).Least MNC was noticed in SVD-0108 (1.85) followed by Kadabinajola (1.85), Dagadi Solapur (1.9), Swati (1.9), SPV-1588 (1.95). highest MNC was recorded in Lakkadi (3.65) (Table 1).

Least MLS was noticed in Kadabina jola (13.7) followed by Swati (16.8), SPV-570 (16.9), SPV-1546 (17.15). The highest MLS was recorded in JP-1-1-5 (39.0). Highest thousand grain weight was recorded in Kadabina jola (30.62 g), followed by BCR-9 (30.15 g) and Honnutagi local (30.00 g).Highest grain yield (kg/ha) was recorded in Honnutagi local (1322) followed by Kadabina jola (1235), BCR-1 (1225.5), Muttagi local-1 (1223.5) (Table 1).

Out of 64 genotypes screened against charcoal rot incidence in sick plot, none of the genotypes showed resistant reaction. Twenty one genotypes showed moderately resistant reaction. Forty two genotypes showed susceptible reaction. One genotype *i.e.*, CSV-8R showed highly susceptible reaction (Table 2). Against lodging, none of them showed resistant reaction. Twenty three lines showed moderately resistant reaction, 41 lines showed susceptible reaction (Table 3).

The results of germplasm screening fall in line with the

Table 1: Screening of germplasm lines against charcoal rot of sorghum caused by *M. phaseolina* (pooled data- two seasons)

Sr. No.	Treatments	Charcoal rot parameters						Yield and yield attributing parameters		
		% Charcoal rot		% Soft stalk		MNC (No.)	MLS (cm)	1000 grain weight (g)	Grain yield (kg/ha)	Fodder yield (t/ha)
1.	Katizapur local	26.60	(28.00)*	30.91	(28.99)*	2.25	27.65	27.85	960.00	2.10
2.	Honnatagi local	24.55	(27.85)	31.96	(33.15)	2.75	28.95	30.00	1322.00	2.27
3.	Managuli local	30.60	(33.57)	51.15	(45.64)	2.30	29.05	28.10	983.00	2.22
4.	Muttagi local	25.90	(30.57)	36.25	(37.00)	2.85	32.55	29.90	1223.50	2.04
5.	Nigal RCR	25.60	(30.38)	33.90	(35.59)	2.30	25.75	26.30	1009.00	2.22
6.	Muttagi local	25.75	(30.47)	41.20	(39.91)	2.30	28.00	27.85	1104.00	2.45
7.	RCRL -5	28.45	(32.22)	41.50	(40.08)	2.35	29.20	25.75	963.50	2.05
8.	Doodmogra	21.30	(27.47)	24.85	(29.82)	2.05	24.35	29.85	1188.00	2.27
9.	Yannigar local	37.05	(37.47)	37.65	(37.83)	2.85	32.75	27.95	1175.00	2.27
10.	Barsi Prakash	31.20	(33.94)	35.95	(36.810	2.30	27.40	28.75	1337.50	2.05
11.	NIC 21265	41.75	(40.23)	36.55	(37.18)	2.70	29.40	27.75	1000.00	2.10
12.	IS 40297	27.60	(31.67)	41.00	(39.790	2.05	29.65	25.65	919.50	2.10
13.	SRS 1	13.15	(21.19)	23.20	(28.77)	2.25	23.75	26.70	993.50	2.01
14.	IS 40296	28.75	(32.40)	46.85	(43.17)	2.10	24.35	28.10	919.50	2.05
15.	NIC 21282	48.40	(44.05)	35.90	(36.79)	2.30	26.35	28.95	1018.00	2.18
16.	RSLG 191	22.80	(28.50)	47.50	(43.54)	2.65	29.00	27.90	881.50	2.15
17.	RSLG 34-2	23.05	(28.67)	25.00	(29.980	2.70	29.50	26.50	923.00	2.16
18.	IS 40298	33.05	(35.07)	17.50	(24.71)	2.30	27.05	28.90	1002.50	2.13
19.	RSLG 262	21.75	(27.77)	25.65	(30.41)	2.25	25.40	26.50	927.50	2.19
20.	SRP 3	29.50	(32.88)	35.35	(36.45)	2.35	25.90	27.90	919.50	2.25
21.	RSLG 241	24.30	(29.51)	26.80	(31.15)	2.05	30.35	29.95	1171.00	2.30
22.	CSV 14 R	23.05	(28.64)	21.80	(27.81)	1.95	24.75	28.15	1031.50	2.15

Table 1 : Contd.....

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23.	CSV 8 R	56.10	(48.49)*	55.80	(48.33)*	3.05	34.15	25.20	817.50	2.10
24.	SPV 1155	28.15	(32.00)	37.05	(37.45)	2.25	25.90	27.40	1041.00	2.29
25.	Swati	26.05	(30.63)	35.35	(36.44)	1.90	16.80	28.65	1156.00	2.15
26.	104 B	32.60	(34.79)	38.90	(38.56)	2.35	26.35	26.45	1018.00	2.17
27.	AKR 150	31.15	(33.89)	32.85	(34.95)	2.30	21.80	26.85	1026.50	2.01
28.	RS 585	25.30	(30.14)	47.70	(43.66)	2.20	20.35	27.75	955.00	2.07
29.	IS 33742	46.65	(43.00)	43.05	(40.98)	2.05	21.35	28.25	975.00	2.20
30.	BRJ 185	27.70	(31.72)	26.40	(30.89)	2.30	22.00	27.40	965.50	2.19
31.	Kannolli local	23.90	(29.25)	23.50	(28.98)	2.65	29.70	29.50	1213.50	2.02
32.	CRP 42	46.80	(43.14)	46.70	(43.08)	2.80	32.85	28.25	1008.50	2.17
33.	DJ 6514	20.90	(27.18)	26.00	(30.64)	2.35	31.20	27.10	1097.00	2.21
34.	M 35-1	35.90	(36.78)	34.70	(36.07)	2.70	27.35	28.70	1102.50	2.15
35.	GRS -1	26.70	(31.10)	18.10	(25.16)	2.30	27.15	28.25	1068.50	2.08
36.	BRJ 182	27.15	(31.39)	41.05	(39.82)	1.95	31.95	27.90	968.50	2.16
37.	Nagaral local	28.70	(32.37)	35.00	(36.25)	2.05	27.65	28.60	917.00	2.32
38.	Muttagi local 2	24.55	(29.68)	27.80	(31.80)	2.25	25.85	28.85	1169.00	2.37
39.	Hattirakihal local 1	32.70	(34.85)	32.25	(34.58)	2.65	28.50	29.20	1067.50	2.27
40.	Hattirakihal local 2	33.55	(35.38)	29.45	(32.85)	2.70	28.90	29.10	1089.00	2.17
41.	Afzalpur local	29.15	(32.66)	25.15	(30.08)	3.20	28.40	27.30	1005.00	2.25
42.	Harnidagadi	22.90	(28.56)	42.10	(40.43)	3.00	21.35	28.15	940.00	2.07
43.	Lakkadi	18.50	(25.46)	32.85	(28.30)	3.65	27.00	27.80	862.00	2.05
44.	Bidar local	26.55	(31.00)	47.70	(37.42)	3.05	32.05	28.35	949.50	2.32
45.	Dhull mallige	38.35	(38.19)*	22.50	(31.16)*	2.05	23.80	29.10	1183.50	2.21
46.	MH Jola	23.15	(28.74)	36.95	(28.50)	2.15	27.65	29.50	1119.50	2.35
47.	BRJ 56	24.50	(29.65)	26.80	(37.42)	2.25	23.65	26.70	905.00	2.35
48.	JP-1-1-5	21.60	(27.66)	22.80	(36.79)	2.30	39.00	27.05	820.50	2.05
49.	Sel -3	34.85	(36.15)	36.95	(37.06)	2.25	26.20	27.50	1011.00	2.25
50.	BRJ- 204	26.65	(31.06)	35.90	(38.24)	2.65	29.15	28.05	1018.00	2.20
51.	SPV-489	29.05	(32.59)	36.35	(37.06)	2.85	30.00	29.60	1217.00	2.29
52.	BRJ 62	28.95	(32.53)	38.35	(36.61)	2.25	26.15	26.75	884.50	2.35
53.	BRJ 67	38.85	(38.53)	36.35	(47.68)	2.05	20.00	25.60	912.50	2.27
54.	IVS- 181	26.25	(30.80)	35.60	(34.31)	2.25	24.15	26.70	871.00	2.37
55.	SPV- 1549	37.30	(37.61)	54.70	(32.66)	2.05	27.00	28.65	1184.50	2.16
56.	SPV- 1546	39.50	(38.92)	31.80	(40.60)	2.25	17.15	28.55	974.50	2.26
57.	SPV- 1548	21.65	(27.71)	29.15	(27.66)	2.00	26.00	29.10	1194.00	2.30
58.	SPV- 1597	34.75	(36.10)	42.40	(40.20)	2.65	21.40	28.45	1046.50	2.00
59.	SPV- 1588	33.05	(35.05)	21.60	(31.59)	1.95	30.15	27.75	915.50	2.21
60.	SVD 0108	27.10	(31.31)	41.70	(29.18)	1.85	22.90	29.90	1095.50	2.29
61.	Dagadi Solapur	12.35	(20.51)	27.50	(25.64)	1.90	21.80	29.55	1122.50	2.34
62.	BCR 9	14.25	(22.14)	23.80	(28.030	2.40	28.05	30.15	1225.50	2.37
63.	Kadabinajola	23.30	(28.83)	18.75	(28.05)	1.85	13.70	30.62	1235.00	2.31
64.	SPV 570	23.00	(28.53)	22.15	(28.04)	2.05	16.90	28.45	939.50	2.17
GM			32.17		34.97	2.37	26.48	28.09	1035.31	2.20
S.E.±			1.85		2.25	0.13	1.82	2.00	60.09	0.14
C.D.(5%)			5.11		6.21	0.36	5.02	5.52	165.85	0.39
C.V			11.51		12.88	11.20	13.72	14.27	11.61	12.41

*- Figures in parenthesis are arc sine values

Table 2: Reaction of sorghum genotypes to charcoal rot incidence

Charcoal rot scale (%)	Genotypes	Reaction
0	–	Immune
1	–	Highly resistant
3	–	Resistant
5	Dagadi Solapur, SRS-1, BCR-9, SPV-570, Kadabinajola, SPV-1548, JP-1-1-5, BRJ-56, MH-Jola, Lakkadi, Harnidagadi, Muttagi local-2, DJ-65-14, Kannolli local, CSV-14R, RSLG-241, RSLG-262, RSLG-34-2, RSLG-191, Doodmogra, Honnutagi local	Moderately resistant
7	Katzipur local, Muttagi local-1, Managuli local, Nigal RCR, Muttagi local-3, RCRL-5, Yennigar local, Barsiprakash, NIC-21265, IS-40297, IS40-296, NIC21282, IS40-298, SRP-3, SPV-1155, Swati, 104B, AKR-150, RS-585, IS-33742, BRJ-185, CRP-42, M-35-1,GRS-1, BRJ-182, Nagaral local, Hattarakihal local-1, Hattarakihal local-2, Afzalpur local, Bidar local, Dhul mallige, Sel-3, BRJ-204, SPV-489, BRJ-62, BRJ-67, VS-181, SPV-1549, SPV-1546, SPV-1597, SPV-1588, SVD-0108	Susceptible
9	CSV-8R	Highly susceptible

Table 3: Reaction of sorghum genotypes to lodging due to charcoal rot

Lodging scale (%)	Genotypes	Reaction
< 10	–	Resistant
10.1 to 30	SRS-1, RSLG-34-2, IS40-298, RSLG-262, RSLG-241, CSV-14-R, BRJ-185, Kannolli local, DJ-6514, GRS-1, Muttagi local-2, Hattarkihal local-2, Afzalpur local, Dhul mallige, BRJ-56, JP-1-15, SPV-1588, SPV-1548, Dagadi solapur, BCR-9, Kadabinajola, SPV-570	Moderately resistant
> 30.1	Katzipur local, Honnutagi local, Managuli local, Muttagi local-1, Nigal RCR, Muttagi local-3, RCRL-5, Yennigar local, Barsiprakash, NIC-21265, IS-40297, IS40-296, NIC21282, RSLG-191, SRP-3, CSV-8R, SPV-1155, Swati, 104B, AKR-150, RS-585, IS-33742, CRP-42, M-35-1, BRJ-182, Nagaral local, Hattarakihal local, Harni dagadi, Lakkadi, Bidar local, MH-Jola, Sel-3, BRJ-204, SPV-489, BRJ-62, BRJ-67, IVS-181, SPV-1549, SPV-1546, SPV-1597, SVD-0108	Susceptible

studies made by Jahagirdar *et al.* (2002). Their study revealed that the local genotypes like Honnutagi local, Kannolli local and Muddehalli jola, recorded reduced levels of charcoal rot parameters. They opined that in these genotypes, delayed senescence in the form of slow drying at physiological maturity, stay green type characters are responsible for charcoal rot tolerance and Padagaonkar and Mayee (1990) were of the opinion that genotypes with low stem water depletion rate will tolerate infection from *M. phaseolina*. Anahosur and Naik (1985) reported that, quantity of sugar was more in resistant genotypes than susceptible genotype. Nalawade *et al*. (2008) reported higher levels of sugar and phenol in the charcoal rot tolerant varieties of sorghum. In the present study, this may be the reason in 21 germplasm lines which showed moderately resistant reaction. Thus, from the results it is clear that employment of newer resistance sources like local genotypes can be effectively employed in resistance breeding programme against charcoal rot in sorghum.

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