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Identification of resistant sources in sesame germplasm to major diseases

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Abstract
Root rot caused by *Macrophomina phaseolina* (Tassi) Goid is the destructive disease in sesame. Foliar diseases *viz*., phyllody, *Alternaria* leaf blight and powdery mildew cause major threat in sesame cultivation. About two hundred sesame germplasm were screened for major diseases *viz*., root rot, phyllody, Alternaria leaf blight and powdery mildew under field conditions. The sesame germplasm *viz*., SI-2116 (18.4%), SIC-17326 (18.2%) and IS-351-2 (19.7%) were found to be moderately resistant to root rot disease. None of the germplasm recorded less than 10% of root rot disease incidence among the 200 germplasms screened. The maximum root rot disease incidence of 64.8% was observed in the susceptible check VRI -1(64.8%). Phyllody disease was found to be the lowest of 5.7% in sesame germplasm *viz*., EC-303440-B. Powdery mildew disease ranged from 0 to 2 grade and *Alternaria* leaf spot disease was observed in the range of 1 to 3 grade.

Keywords: Sesame, germplasm, screening, diseases

Introduction

Sesame seed is a rich source of protein (20%), edible oil (50%), oleic acid (47%) and linolenic acid (39%). Although sesame is widely used for different purposes, it has low productivity due to non-availability of high-yielding varieties, resistant variety to biotic and abiotic stresses, low harvest index, seed shattering and indeterminate growth habit (Vyas *et al*., 1984) [10]. The low productivity of sesame has been attributed to pests and disease occurrence (Buldeo and Rane, 1978) [1]. Many diseases attack sesame, but only a few of them such as Fusarium wilt, charcoal rot, stem and root rot, bacterial blight, bacterial leaf spot, Cercospora leaf spot, Alternaria leaf spot, powdery mildew, leaf curl and phyllody are considered to be important diseases of sesame in the world and it occurs wherever sesame is cultivated. Among the diseases, root rot caused by *Macrophomina phaseolina* (Tassi) Goid is the most serious one affecting the crop at the later stages of growth. Maiti *et al*. (1988) [6] reported an estimated yield loss of 57% at about 40% of disease incidence. The most common symptom of the disease is the sudden wilting of growing plants mainly after the flowering stage, the stem and roots become black due to severe infection. High temperature and water stress during growing season favours the pathogen's incidence (Chattopadhyay and Kalpana Sastry, 1998) [2]. Association of phytoplasma has been confirmed with phyllody disease in India on the basis of symptoms, electron microscopy and molecular approaches but only up to group level the incidence of phyllody disease increased day by day in sesame growing areas. Phyllody is associated with a mycoplasma-like organism (MLO) in the phloem of affected plants. It is transmitted by leafhopper. Singh (1987) [9] reported 5-85 per cent yield losses due to *Alternaria* leaf spot disease.

Hence, the present study was conducted to assess the extent of damage caused by various diseases in sesame germplasm in order to identify the resistant sources for major diseases.

Materials and Methods

Sesame (*Sesamum indicum* L.) plants showing typical root rot symptoms were collected and the isolation of fungus was done following the standard tissue isolation technique. Those parts of root and stem showing typical symptoms of the disease were washed in running tap water and cut into small bits. These bits were surface sterilized with 0.1 per cent mercuric chloride

solutions for 30 seconds and washed thoroughly in sterile distilled water for three times to remove traces of mercuric chloride and then aseptically transferred to sterilized potato dextrose agar (PDA) plates and incubated at 27±1ºC for three days for fungal growth. Later, the bit of fungal growth was transferred to PDA slants. The pure culture of the fungus was obtained by further growing the culture under aseptic conditions by following hyphal tip culture method (Rangaswami, 1972) [7]. After seven days of incubation, pure isolates were obtained and maintained at 4ºC for further studies.
The pathogenic ability of *M. phaseolina* (isolated from the diseased stem) was tested in screen house on sesame. Culture of *M. phaseolina* was raised in 250 ml Erlenmeyer flask containing 50 ml of PDB (potato dextrose broth) sterilized at 15 lbs per sq inch pressure for 20 minutes. The bits of 5 mm size were cut with the help of sterilized cork borer from fresh pure culture plates (5 days old) and transferred into flasks with the help of sterilized needle under aseptic conditions. After seven days of incubation in BOD incubator at 27±1˚C, mycelial mats were collected and dried between folds of blotting paper for further use. Five gram of fresh mycelial mat was homogenized in blender for 2 minutes at lowest speed in 1000 ml of sterilized water. The suspension was used to inoculate the pots containing 5 kg of sand: ground sesame seed mixture (9:1) which was sterilized by autoclaving at 15 psi for one and half hours for two consecutive days. On the third day of inoculation, thirty seeds of sesame were sown in pots. Pots were irrigated regularly to maintain moisture. After 8-10 days of sowing, the symptoms appeared and the infected plants exhibited elongated lesions at collar region which will be later converted to dark brown to black and stem was completely girdled by the lesions. The affected plants wilted and dried up later. Diseased plants were brought to laboratory and isolations were made on PDA medium from diseased stem to confirm the identity of pathogen (Riker and Riker, 1936) [8].

Evaluation of sesame germplasm for resistance to major diseases

The field trial was conducted at New farm, Regional Research Station, Vridhachalam during *kharif* 2018 under sick plot conditions created for root rot pathogen, *Macrophomina phaseolina*. About two hundred sesame germplasm along with the susceptible check VRI -1were screened against major diseases of sesame under field conditions in Randomized block design in two rows of 3 m length and replicated thrice. In addition to root rot disease, other diseases *viz*., phyllody, *Alternaria* leaf blight and powdery mildew disease incidences were recorded under field conditions. The root rot disease and phyllody disease incidence were recorded at 70 days after sowing by counting the number of diseased plants and total plants. *Alternaria* leaf blight and powdery mildew disease intensity was recorded using the grade 0-5 scale. The sesame germplasm were graded as resistant, moderately resistant, moderately susceptible, susceptible or highly susceptible based on their infection percentage using the scale given by Dinakaran and Naina Mohammed (2001) [3].

Disease scale	Per cent infection (%)	Reaction
1	1-10	Resistant
3	11-20	Moderately resistant
5	21-30	Moderately susceptible
7	31-50	Susceptible
9	51-100	Highly susceptible

The reaction of sesame genotypes to diseases was assessed and the results were furnished in Table 1.

Results and Discussion

In the present study, two hundred sesame germplasm were evaluated along with the susceptible check VRI-1 against major diseases. Three types of disease response i.e., moderately resistant, moderately susceptible and susceptible reactions were observed in the present study. Among the 200 sesame germplasm lines screened under sick plot conditions, disease incidence of root rot ranged from 18.2% (SIC-17326) to 68.4% (KMR-1). The lowest root rot disease incidence of 18.2% was recorded in the sesame germplasm *viz*., SIC-17326. The maximum root rot disease incidence was observed in the sesame germplasm *viz*., KMR-1. From the results it was found that the sesame germplasm *viz*., SI-2116 (18.4%), SIC-17326 (18.2%) and IS-351-2 (19.7%) were found to be moderately resistant to root rot disease (Table 1).
The sesame germplasm *viz*., ICA-14146-A (21.3%), IS-100-8 (24.6%), SI-76-1(21.4%), EC-335010 (24.8%), EC-335010 (21.4%), SI-1033 (20.4%), EC-33962 (24.6%), SI-253 (21.8%), ES-75-2-84 (24.2), IS-461-1-84-I (24.8%), NIC-163-88 (21.2%), GSM-22 (24.7%), S-0308 (22.6%), GRT-83135 (24.7%), IS-355 (20.6%), SI-3218 (24.7%), MIC-8526 (22.8%), EC-310421 (20.6%), NAL/28/27/31/4 (24.7%), KMR-77-I (20.3%), B-203 (21.7%), S-0337 (21.3%), NIC-16236 (20.4%), EC-303445 (21.6%), NIC-8533 (22.4%), IC-96113 (22.3%), GRT-8339 (21.4%), IC-14120-1 (22.7%), NIC-8165 (21.7%), ES-29 (22.8%), S-0439 (21.9%), IC-131485 (20.4%), IC-204595 (21.7%), NIC-10622 (21.8%), SI-1818 (22.4%) ES-150-1 (21.4%), SI-2952 (21.6%), KMR-27 (21.2%), ES-20 (21.4%), KMR-10 (22.8%), KMR-22 (21.6%), IS-199 (21.7%), S-0534 (22.8%), IS-201 (21.4%), KM-86 (22.7%) and ES-110 (21.4%) recorded root rot disease incidence from 20.0 to 25.0% (Moderately susceptible). From the screening results, it was found that rest of the lines were found susceptible to root rot disease (Table 1).
The sesame germplasm *viz*., SI-3179, SI-3231, EC-335011-A, IS-665, EC-334984, EC-334001, IS-461-1-84, EC-334995, EC-3349997, KMR-1, IS-17, IS-722-2-84, IS-3179, IS-393-1, SI-995, SI-2008, NIC-8288, S-0228, S-022, GRT-8359-I and KMS-322-I recorded maximum root rot disease incidence at the time of physiological maturity. None of the germplasm recorded less than 10% of root rot disease incidence among the 200 germplasms screened. The maximum root rot disease incidence of 64.8% was observed in the susceptible check VRI -1(64.8%). Phyllody incidence ranged from 5.7% (EC-303440-B) to 18.4.% (SI-3237) among the sesame germplasm screened. The susceptible check VRI -1recorded the maximum phyllody disease incidence of 23.6%. Powdery mildew disease incidence ranged from 0 to 2 grade among the 200 sesame germplasms screened. In the screening of sesame germplasm, *Alternaria* leaf spot incidence was observed in the range between 1 to 3 grade (Table 1).
The sesame germplasm *viz*., SI-1156(8.7%), EC-335011-A(9.4%), BC-303427(7.9%), IS-665(6.4%), SI-3234(6.2%), IS-475(9.3%), IS-100-8(7.6%), SI-1679(8.3%), SI-76-1(7.4%), EC-334984(7.2%), SP-1144(8.3%), EC-334001(9.7%), KIS-398(8.4%), KIS-398(7.6%), EC-334973(8.1%), EC-178-2(8.4%) recorded lesser phyllody disease incidence (Table 1).
Identification of disease resistant lines is a major goal for plant breeders. Breeding for disease resistance requires efficient, low-cost and rapid screening techniques (Foolad *et al*., 2000) [5]. In the present study, there was no perfect

resistance was observed although germplasm having perfect resistance (without symptom) to wilt disease was reported previously (El-Shazly *et al*., 1999) [4]. However, the identified moderately resistant lines may be utilized for breeding programmes to broaden the resistance against major diseases of sesame.

Table 1: Screening of sesame germplasm against major diseases

S. No.	Germplasm	Root rot (%)	Phyllody (%)	*Alternaria* leaf spot (0-5 scale)	Powdery mildew (0-5 scale)
1	SI-3237	36.2	18..4	2	1
2	IC-131607	44.6	17.6	3	2
3	SI-3179	56.3	14.7	3	1
4	SI-3231	60.4	13.9	2	0
5	EC-33507	54.8	14.2	1	2
6	IS-321	48.6	16.3	2	1
7	SI-1156	20.3	8.7	1	0
8	EC-335011-A	57.2	9.4	2	1
9	EC-334990	28.4	12.3	1	0
10	EC-334989	26.7	11.6	1	0
11	ICA-14146-A	21.3	13.4	2	1
12	BC-303427	3.6	7.9	2	2
13	IS-665	56.9	6.4	3	1
14	SI-3234	51.4	6.2	2	1
15	EC-334280	44.3	10.6	3	2
16	S-0182-I	48.6	11.4	2	0
17	IS-475	40.3	9.3	2	1
18	EC-334983	45.8	12.6	1	1
19	KIS-375	48.7	10.4	3	2
20	Agra-balik	54.3	11.3	2	0
21	IS-100-8	24.6	7.6	1	2
22	SI-1679	36.7	8.3	1	0
23	SI-76-1	21.4	7.4	1	1
24	EC-334984	66.2	7.2	2	1
25	SP-1144	32.6	8.3	3	2
26	EC-334950-I	36.4	10.4	2	1
27	EC-335010	24.8	11.3	1	1
28	EC-334001	57.1	9.7	3	0
29	EC-334979	48.4	10.6	2	1
30	KIS-398	51.6	8.4	3	2
31	EC-334977	54.9	7.6	2	2
32	KIC-1634-B	36.6	10.8	1	1
33	EC-334973	39.8	8.1	2	1
34	EC-178-2	48.2	8.4	2	2
35	SI-1516	42.7	10.3	1	1
36	IS-728	39.6	7.8	2	1
37	EC-334985-I	44.2	7.2	3	2
38	EC-334994	21.4	6.7	1	2
39	EC-334974	45.7	8.3	2	1
40	SI-349	54.6	10.6	2	1
41	IS-461-1-84	63.2	9.4	3	0
42	EC-334999	39.8	8.1	2	2
43	NIC-7905	28.3	9.2	1	1
44	SI-1687	42.5	7.6	2	1
45	EC-3340998	33.8	9.7	1	2
46	SI-1033	20.4	11.3	1	2
47	EC-665	26.2	8.6	1	1
48	SI-1225	36.7	9.7	2	0
49	IS-366	58.2	8.3	3	1
50	EC-33962	24.6	10.6	1	2
51	IS-723	26.3	9.7	1	0
52	SI-253	21.8	10.4	2	0
53	S-0388	38.7	8.7	2	1
54	ES-75-2-84	24.2	10.2	1	1
55	ES-334966	28.4	8.3	1	2
56	ES-81	51.7	7.4	3	0
57	IC-199443	42.4	9.2	2	1
58	EC-334995	62.6	8.6	2	2
59	EC-3349997	64.1	10.3	1	2
60	KMR-1	68.4	9.7	2	1
61	ES-62	48.3	13.4	2	1
62	SI-2192	36.7	16.2	3	2

63	IS-17	64.9	15.7	2	1
64	IS-722-2-84	62.3	11.3	2	2
65	IS-3179	61.8	9.7	2	1
66	IS-446-1-64	28.6	12.4	1	2
67	IS-393-1	68.3	13.7	3	2
68	EC-303440-B	42.6	5.7	2	2
69	IS-461-1-84-I	24.8	8.6	1	1
70	EC-335005	27.3	7.4	2	1
71	NIC-163-88	21.2	6.9	2	2
72	SI-995	63.8	7.3	3	1
73	SI-1345	36.4	12.7	2	2
74	SI-63	45.1	13.6	2	1
75	EC-334993	28.8	16.4	1	2
76	SI-2008	60.7	11.7	2	0
77	NIC-8288	62.4	13.4	2	1
78	EC-334971	48.3	10.6	1	2
79	EC-310439	54.2	11.7	2	2
80	SI-7192	56.4	8.6	3	1
81	SI-3070	34.6	10.4	1	1
82	GSM-22	24.7	12.6	1	2
83	SI-2973	38.2	9.7	2	1
84	S-0308	22.6	12.4	1	1
85	NIC-16328	26.8	8.6	2	2
86	GRT-83135	24.7	9.7	2	0
87	GRT-83125	29.3	13.4	2	2
88	IS-56	39.6	11.7	3	1
89	NIC-16268	27.4	9.4	2	1
90	NIC-16275	48.6	10.3	2	2
91	NIC-8984	33.2	14.6	1	0
92	MT-67-25	28.1	11.7	1	1
93	IS-355	20.6	16.2	2	0
94	SI-3218	24.7	9.4	2	2
95	MIC-8526	22.8	10.3	2	1
96	SI-2116	18.4	13.4	1	2
97	SIC-17326	18.2	9.7	1	1
98	EC-310421	20.6	13.6	1	0
99	S-0335	27.8	11.4	2	1
100	NAL/28/27/31/4	24.7	10.7	2	2
101	IC-14093	32.4	14.9	2	1
102	KMR-77-I	20.3	7.3	1	0
103	IS-351-2	19.7	9.7	2	1
104	S-0448	32.6	17.6	3	2
105	KIS-375-I	24.3	12.3	2	1
106	GRT-83148	26.9	14.4	1	0
107	B-203	21.7	9.7	1	1
108	IC-14160-I	24.8	10.3	2	2
109	S-0337	21.3	8.6	1	1
110	KMR-17	39.6	9.4	2	2
111	IC-96128	54.8	11.3	3	2
112	S-0228	57.4	9.7	2	1
113	S-0434	62.7	7.9	3	2
114	ES-110-C	56.3	7.4	2	1
115	IS-607-1-84	54.9	9.6	2	0
116	NIC-16236	20.4	11.4	1	0
117	SI-1926	28.7	13.2	1	0
118	NIC-13598	32.6	9.7	2	2
119	IS-308-A	36.5	16.3	2	1
120	MT-67-61	28.1	13.4	1	2
121	IS-37	36.8	10.3	3	1
122	78-301	29.3	9.7	2	1
123	S-0430	33.8	8.9	2	2
124	GRT-8359-I	62.7	9.3	3	2
125	SI-2008	39.6	11.4	2	1
126	IS-309	29.4	10.7	2	1
127	SI-2940	38.7	9.4	3	2
128	IC-382-2	28.6	13.6	2	1
129	SI-1061	42.3	12.4	3	2
130	KMS-322-I	56.4	11.7	3	2
131	KIS-219	26.7	10.9	1	0

132	EC-303445	21.6	8.6	1	1
133	NIC-8533	22.4	6.4	1	2
134	VCR/82/No/10/NS	28.2	8.3	1	1
135	IC-96113	22.3	7.9	2	1
136	NIC-9839-I	48.8	10.3	3	2
137	SI-3280-I	42.6	9.2	2	1
138	GRT-8339	21.4	10.7	1	0
139	EC-303419	29.6	8.4	2	2
140	RJS-56	38.2	10.3	3	2
141	DSK-1	38.6	12.7	2	0
142	IC-14120-1	22.7	10.3	1	1
143	49-E-SPS-6	32.6	9.6	3	2
144	ES-48	24.3	13.4	2	0
145	NIC-8165	21.7	11.7	2	1
146	ES-29	22.8	11.2	2	1
147	NIC-8559	36.4	8.6	3	2
148	EC-334950	23.6	12.7	1	0
149	S-0439	21.9	10.3	2	1
150	IC-131485	20.4	9.6	2	1
151	IC-204595	21.7	7.3	2	1
152	RJS-124	24.3	12.7	2	2
153	NIC-8202	33.6	9.6	3	2
154	NIC-10622	21.8	8.3	1	1
155	KMR-38	36.2	10.7	2	2
156	Kanpur local	33.7	9.6	2	1
157	KMR-77	48.6	9.3	2	2
158	ICA-14105	34.8	7.4	2	1
159	GRT-83147	52.1	8.1	3	2
160	NIC-7913	32.6	9.6	2	1
161	IS-649	36.3	7.4	3	2
162	SI-1818	22.4	8.7	3	1
163	ES-249	48.6	9.3	1	2
164	ES-2186-2	36.2	11.6	2	1
165	NIC-8060	28.3	10.3	3	2
166	NIC-7943	32.4	7.9	2	0
167	ES-28	39.6	8.7	2	1
168	MT-6262	28.1	7.3	3	2
169	SI-3283	48.3	6.9	2	2
170	S-0130	26.7	7.2	1	1
171	ES-150-1	21.4	8.3	1	0
172	NIC-16347	23.6	6.7	2	1
173	SI-2174	54.3	6.1	2	2
174	NIC-16129	52.1	11.3	2	1
175	B-7-11	24.2	8.7	3	2
176	TS-261	28.6	10.6	2	2
177	RJS-193	36.1	7.4	1	0
178	NIC-16324	29.8	8.1	1	1
179	SI-2952	21.6	7.9	3	2
180	ES-40	28.4	10.3	2	0
181	KMR-27	21.2	9.4	2	1
182	KMR-112	24.3	8.3	2	2
183	ES-20	21.4	5.6	1	0
184	KMR-35	23.7	7.9	2	1
185	KMR-10	22.8	12.4	2	2
186	KMR-33	26.1	9.6	1	1
187	KMR-114	24.9	10.3	2	2
188	KMR-22	21.6	8.6	1	2
189	S-0579	24.9	9.3	2	1
190	KMS-04-262	23.2	7.4	2	1
191	IS-199	21.7	8.7	1	2
192	SI-3315-5	23.4	6.3	3	2
193	S-0534	22.8	10.6	2	0
194	KMS-4-235	23.7	13.1	2	2
195	KM-90	28.3	15.4	2	1
196	IS-653	42.6	7.9	3	2
197	IS-201	21.4	8.3	1	0
198	KM-76	36.2	12.4	2	1
199	KM-86	22.7	10.6	1	2
200	ES-110	21.4	8.3	1	1

201	Check VRI -1	64.8	23.6	3	2`
	CD (P=0.05)	3.1	3.8	-	-

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