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Screening of sesame (*Sesamum indicum* L.) germplasm for host-plant resistance against Alternaria leaf blight incited by *Alternaria sesami*

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Abstract
Sesame (*Sesamum indicum* L.), is one of the world's ancient oilseed crop cultivated in more than 55 countries of the world, belonging to the family *Pedaliaceae* and native to India. Alternaria blight disease in sesame is one of the most detrimental diseases causing significant yield losses to the crop. The disease caused by *Alternaria sesami* is responsible for the low productivity of sesame in India. Sesame varieties presently under cultivation do not posses any effective field resistance and majority of them are more or less prone to the leaf blight disease (*Alternaria sesami*). Thus, the present study was aimed to identify the resistance sources in the germplasm of sesame for further exploitation in resistance breeding programme. None of the sesame entry was found immune or highly resistant to the disease. However, 35 genotypes were found moderately resistant to the disease and rest of the germplasm showed moderately susceptible reactions against the disease.

Keywords: Sesame, *Alternaria sesami*, screening, disease severity

1. Introduction
Sesame (*Sesamum indicum* L.), is one of the most important world's ancient oilseed crop belonging to the family Pedaliaceae. Sesame is a herbaceous, annual, self-pollinated (considerable insect cross pollination) crop with 2n = 26 chromosomes. It is commonly known as "Til" in India, which has also been mentioned in Atharva Veda, Ashtadavaiji, Manusmriti and Puranas as "Tila" indicating the presence of sesame in India since the pre-Christian era. Sesame is considered as "Queen of oilseeds" and its seeds are a rich source of protein (20%), edible oil (50%), oleic acid (47%) and linolenic acid (39%) [1]. It is also a rich source of potassium (525.9 mg/100 g) phosphorus (516 mg/100 g) and Magnesium (349.9 mg/100 g) [2]. Hull of sesame accounts for 15-20% of the whole seed and contains 2-3% oxalic acid and 1-2% calcium and is high in fiber. Sesame seeds have health benefits like reduction in high blood pressure, anti-oxidant activities, anticancer property and hypocholesterolemic effects [3].
Among all the states in India, Uttar Pradesh holds the maximum area under sesame cultivation (4.02 lakh ha) accounting 26.26% of the total area however, it ranks fourth in terms of production (1.19 lakh tonne) contributing only 14.09% of total production ranking next to West Bengal, Gujrat and Madhya Pradesh, with productivity of only 2.97 q/ha that is quite below the national average productivity [4]. Various biotic and abiotic factors are responsible for the lower yields of sesame. Among biotic factors, one of the most important and widespread diseases that hamper the sesame production and productivity all over the country is Alternaria leaf spot/blight caused by *Alternaria sesami* (Kawamura) Mohanty and Behera. Alternaria leaf blight of sesame has been reported to cause 20 to 40 percent yield losses all over India [5, 6]. The disease was first reported by [7] from Uttar Pradesh, which spread in sesame growing region of the country [8, 9].
The disease appears from seedling stage to harvesting of the crop. The infection remain continues even after harvesting of the crop due to dew deposition on the stems and capsules during early morning. The fungus is known to cause seed rot, pre and post-emergence death of the seedling and infect all the above ground parts of the plant resulting in considerable

lasses on yield both as quantitatively and qualitatively. Cultivation of resistant varieties is the most effective, cheap and ecofriendly method of disease management, so screening of sesame germplasm was carried out at the research form of BUAT Banda, Uttar Pradesh (210001).

2. Materials and Methods

Field trial for screening of 123 genotypes belonging to sesame was conducted in the Agricultural Research Farm of College of Agriculture, BUAT Banda (Uttar Pradesh) in augmented RCBD for source of resistance in the *Kharif* season 2022 and 2023 to assess the reaction of sesame germplasm against *Alternaria sesami*, under natural epiphytotic conditions. A total of 123 entries of sesame during both the years, were sown at 30×10 cm spacing. Each germplasm was replicated tree times during both the years (2022 and 2023). All germplasm were sown on 19th July during both the years in 5mt long rows. Two rows of susceptible check (Pragati and GT-10) and a single row of resistant check (TKG-22) were sown after each 15 rows of germplasm.

Data on percent disease index (PDI) was taken at maturity with at least 15 days before the harvest of crop. Observation on Alternaria leaf blight intensity was recorded on five randomly selected plants tagged from each replication of each germplasm. Each selected plant was tagged and 15 leaves (5 lower, 5 middle and 5 upper parts of plants) were observed for disease reaction by putting and comparing with the 0-5 grade rating scale given by [10] as given in Table 1. Numerical rating grades were given on the basis of percentage of area covered by pathogen on the selected leaves. On the basis of disease intensity different genotype lines were classified into different groups namely, immune, highly resistant, resistant, moderately resistant, susceptible and highly susceptible.

Table 1: Disease rating scale for Alternaria leaf blight disease of sesame

Rating scales	Disease intensity (%)/Infection in leaf (% area)	Disease reaction
0	No infection	Immune (I)
1	>5% area covered	Highly resistant (HR)
2	6-10% area covered	Resistant (R)
3	11-25% area covered	Moderately resistant (MR)
4	26-50% area covered	Susceptible (S)
5	>50% area covered	Highly susceptible (HS)

The percent disease severity was calculated according to the formula given by [11]. Disease severity (%) = (Sum of all disease ratings/Total number of disease ratings × Maximum disease grade) × 100. The data was analyzed using R software.

3. Results and Discussion

The Percent disease index varied from 13.55 to 40.77 percent and none of the germplasm was found to be completely free (0% PDI) from the disease.

Out of 123 germinated genotypes of the sesame, 35 germplasm/varieties *viz*. GP-25, GP-19, GP-65, GP-151, GP-96, GP-7, GP-150, GP-160, GP-78, GP-49, GP-38, GP-79, GP-82, GP-44, GP-177, MT-2015-5-1, MT-2020-13, MT-2017-11, MT-2017-07, JSL-8, HT-2, NIL-16426, GRT-8336, EC-334961-1, SI-387, NIC-8339, GP-114, GP-139, G-2, GAD-5, EC-334957, IS-449, MT-2 and TKG-22 exhibited less than 25 percent disease index and considered as moderately resistant (11-25 PDI).

Whereas, rest of 86 germplasm *viz*. MT-2019-5, GP-41, GP-178, GP-34, GP-48, GP-15, GP-51, GP-4, GP-45, GP-166, GP-73, GP-146, GP-50, GP-40, GP-153, GP-98, GP-156, GP-75, GP-168, GP-165, GP-5, GP-3, GP-68, GP-179, GP-161, GP-183, GP-182, GP-28, GP-27, GP-97, GP-76, GP-11, GP-70, GP-43, GP-46, GP-54, GP-140, GP-23, GP-72, GP-39, GP-80, GP-22, GP-70, GP-145, GP-149, GP-20, GP-63, GP-64, GP-77, GP-37, MT-2019-13, MT-10-5-1, IS-52, Saloni white, UMA, GP-53, GP-157, NIC-8401, NIC-8282, GP-57, Belatal local, NIC-8165, NIC-8394, EC-303423c, GP-147, SI-1687-1, GP-81, G-12, GP-167, FC-31045, GP-146, GP-67, PCU-34, GP-56, RI-351, S-0268-c, TC-206, SP-41, TC-190, GP-14, MT-2017-11, LCB, LCT, MT-1, MT-3, Pragati and GT-10 were found to be susceptible, which exhibited more than 26 percent disease index (26-50% DI).

Disease index in susceptible checks (Pragati and GT-10) was more than 26 percent whereas, the check TKG-22 fell under moderately resistant category, as it exhibited less than 25 percent disease severity.

Alternaria blight disease has been reported to cause signification yield losses (15.7-55.2%) in sesame [12] and other crops also [13], and host-plant resistance has always been the most effective and safest tools in disease management [14]. also screened 963 sesame cultivars grown under natural infection and examined 60 days after sowing, none was resistant to *Alternaria sesami* but 12 were moderately resistant, 12 showed a susceptible reaction when inoculated.

The screening of 73 genotypes, among which, none of the genotypes had shown immune and highly resistant reaction, while Takire Local showed moderately resistant reaction and Krishna showed moderately susceptible reaction to *Alternaria sesami* [15]. Similarly, screening for the host plant resistance has also been conducted by several workers from the country [16, 17, 18].

Table 2: Severity of Alternaria blight of sesame germplasm during 2022 and 2023

Sr. No.	Germplasm/lines	Percent disease index (%)			Sr. No.	Germplasm/lines	Percent disease index (%)		
		2022	2023	Pooled			2022	2023	Pooled
1	MT-2019-5	28	28.22	28.11	63	GP-64	28.55	29.44	29
2	GP-41	30.33	31	30.67	64	GP-77	37.66	30.78	34.22
3	GP-178	25.66	27.89	26.78	65	GP-44	14.77	15.44	15.11
4	GP-34	24.44	26.44	25.44	66	GP-37	31.44	40.55	36
5	GP-48	26.88	27.22	27.05	67	GP-177	23.66	23.66	23.66
6	GP-25	19.29	17.88	18.59	68	MT-2019-13	20.11	32.66	26.39
7	GP-15	27.99	23.33	25.66	69	MT-2015-5-1	27.22	21.66	24.44
8	GP-51	29.11	31.11	30.11	70	MT-2020-13	21	21.77	21.39
9	GP-4	25.33	27.22	26.28	71	MT-2017-11	22.99	23.89	23.44
10	GP-45	32.44	34.44	33.44	72	MT-10-5-1	24	26.55	25.28
11	GP-166	27.88	27.99	27.94	73	MT-2017-07	13.55	15.55	14.55
12	GP-19	23.11	23.11	23.11	74	JSL-8	23.11	25.11	24.11
13	GP-12	25.89	26.67	26.28	75	IS-52	33.77	35.11	34.44
14	GP-73	34.33	35.22	34.78	76	Saloni white	33.33	33.77	33.55
15	GP-146	26.55	27.55	27.05	77	HT-2	25.66	23.89	24.78
16	GP-50	30.44	28.89	29.67	78	UMA	26.44	26.66	26.55
17	GP-40	33.89	37.66	35.78	79	GP-53	29	32.55	30.78
18	GP-153	25.66	31.88	28.77	80	NIL-16426	23.33	23.99	23.66
19	GP-98	27.89	33.78	30.84	81	GP-157	36	38	37
20	GP-65	20.33	20.55	20.44	82	NIC-8401	26.88	25.55	26.22
21	GP-156	24.88	40.77	32.83	83	NIC-8282	30.88	29.11	30
22	GP-75	25.55	25.66	25.61	84	GP-57	29.33	23.55	26.44
23	GP-168	26	25.33	25.67	85	Belatal local	28.44	29.33	28.89
24	GP-165	39.66	23.44	31.55	86	NIC-8165	34	34.88	34.44
25	GP-151	24.22	24.67	24.45	87	NIC-8394	31.89	31.89	31.89
26	GP-5	26.44	28	27.22	88	EC-303423c	32.66	36.44	34.55
27	GP-96	27.11	22.33	24.72	89	GP-147	33.77	32.22	33
28	GP-7	21.66	25.44	23.55	90	GRT-8336	23.99	20.66	22.33
29	GP-3	28.33	30.33	29.33	91	EC-334961-1	23.11	25.11	24.11
30	GP-150	19.88	23.78	21.83	92	SI-387	20.55	23.33	21.94
31	GP-68	26.66	27.66	27.16	93	SI-1687-1	29.22	33	31.11
32	GP-179	28.11	29.11	28.61	94	GP-81	30.22	30.33	30.28
33	GP-161	33.33	34.77	34.05	95	NIC-8339	17.44	19.66	18.55
34	GP-183	31.55	31.22	31.39	96	G-12	31.11	34.55	32.83
35	GP-182	25.89	27.44	26.67	97	GP-144	20.11	23.55	21.83
36	GP-28	35.22	36.11	35.67	98	GP-167	24.44	29.11	26.78
37	GP-27	30.55	33.88	32.22	99	FC-31045	27.44	29.22	28.33
38	GP-97	27.89	23.77	25.83	100	GP-139	21.88	22.55	22.22
39	GP-76	30.22	27.33	28.78	101	G-2	22.66	26.22	24.44
40	GP-160	15.11	19.33	17.22	102	GAD-5	22.11	24.44	23.28
41	GP-11	29.88	32.55	31.22	103	GP-146	29.44	32.66	31.05
42	GP-70	26.77	25.77	26.27	104	GP-67	28	31.66	29.83
43	GP-78	23.11	23.66	23.39	105	PCU-34	27.44	29.22	28.33
44	GP-73	27.44	26.22	26.83	106	EC-334957	22.66	23.77	23.22
45	GP-43	32.11	35.88	34	107	GP-56	30.99	32.66	31.83
46	GP-49	17.77	27.66	22.72	108	RI-351	30.11	33	31.56
47	GP-46	34.77	29.11	31.94	109	S-0268-c	32.22	33.77	33
48	GP-54	32.89	34.77	33.83	110	TC-206	25	27.11	26.06
49	GP-140	31.44	31.22	31.33	111	IS-449	18.77	22.66	20.72
50	GP-23	24	27.44	25.72	112	SP-41	32.22	33.33	32.78
51	GP-72	30.33	36.11	33.22	113	TC-190	25.55	28.66	27.11
52	GP-39	31.88	33.88	32.88	114	GP-14	34.44	38	36.22
53	GP-80	32.55	23.77	28.16	115	MT-2017-11	28.66	31.66	30.16
54	GP-22	36	27.33	31.67	116	LCB	27.88	31.11	29.5
55	GP-38	25	19.33	22.17	117	LCT	25.33	28.78	27.06
56	GP-70	32.22	32.55	32.39	118	MT-1	28.22	30.77	29.5
57	GP-145	28.44	25.77	27.11	119	MT-2	14.89	17.44	16.17
58	GP-79	16.77	23.66	20.22	120	MT-3	24	26.44	25.22
59	GP-149	31.33	26.22	28.78	121	TKG-22 (Check)	22.34	22.6	22.47
60	GP-20	23.77	35.88	29.83	122	Pragati (Check)	30.36	32.93	31.65
61	GP-82	22.22	26.88	24.55	123	GT-10 (Check)	27.67	30.82	29.25
62	GP-63	25.77	30.44	28.11		CD(p = 0.05)	3.64	4.09	

Table 3: Reaction of sesame germplasm against Alternaria leaf blight

Rating	Disease reaction	Disease index (%)	Disease reaction on the basis of Pooled PDI (2022 & 2023)	
			Number	Name of germplasm
0	Immune	0	-	-
1	Highly resistant	<5%	-	-
2	Resistant	5-10%	-	-
3	Moderately resistant	11-25%	34	GP-25, GP-19, GP-65, GP-151, GP-96, GP-7, GP-150, GP-160, GP-78, GP-49, GP-38, GP-79, GP-82, GP-44, GP-177, MT-2015-5-1, MT-2020-13, MT-2017-11, MT-2017-07, JSL-8, HT-2, NIL-16426, GRT-8336, EC-334961-1, SI-387, NIC-8339, GP-114, GP-139, G-2, GAD-5, EC-334957, IS-449, MT-2 and TKG-22
4	Susceptible	26-50%	86	MT-2019-5, GP-41, GP-178, GP-34, GP-48, GP-15, GP-51, GP-4, GP-45, GP-166, GP-73, GP-146, GP-50, GP-40, GP-153, GP-98, GP-156, GP-75, GP-168, GP-165, GP-5, GP-3, GP-68, GP-179, GP-161, GP-183, GP-182, GP-28, GP-27, GP-97, GP-76, GP-11, GP-70, GP-43, GP-46, GP-54, GP-140, GP-23, GP-72, GP-39, GP-80, GP-22, GP-70, GP-145, GP-149, GP-20, GP-63, GP-64, GP-77, GP-37, MT-2019-13, MT-10-5-1, IS-52, Saloni white, UMA, GP-53, GP-157, NIC-8401, NIC-8282, GP-57, Belatal local, NIC-8165, NIC-8394, EC-303423c, GP-147, SI-1687-1, GP-81, G-12, GP-167, FC-31045, GP-146, GP-67, PCU-34, GP-56, RI-351, S-0268-c, TC-206, SP-41, TC-190, GP-14, MT-2017-11, LCB, LCT, MT-1, MT-3, Pragati and GT-10
5	Highly susceptible	>50%	-	-

4. Conclusion

Sesame is one of the major crops being grown in India for edible oil and medicinal purposes and Alternaria blight disease posses a major threat in the production of the crop. As growing resistant and tolerant varieties against the disease is safest and most eco-friendly approach to counter the crop diseases, the findings of this study can be utilized for breeding against the disease so as to develop varieties which would be resistant to Alternaria blight disease by utilizing the most potential resistant sources screened in current findings.

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