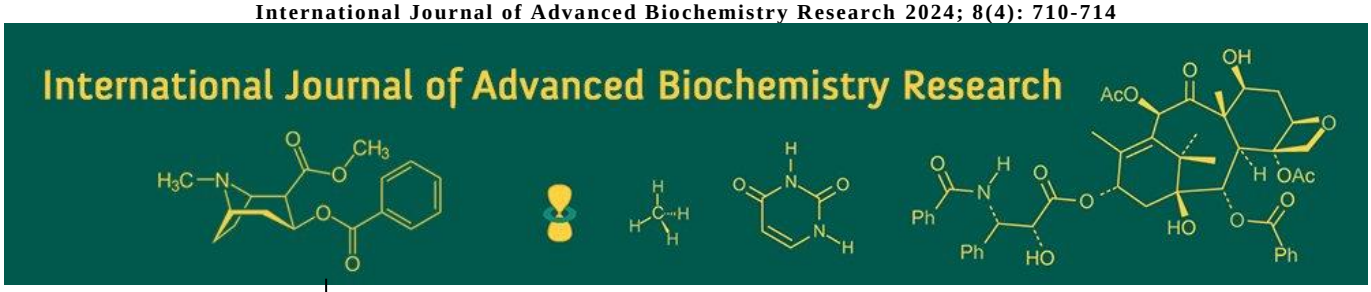

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Screening of sesame germplasm against major foliar diseases

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Abstract
Sesame being one of the oldest oilseed crop is affected by various diseases. A total of 45 genotypes were screened for this study, none were found to be immune or resistant to *Alternaria* leaf blight, but six genotypes *i.e.*, TKG-22, King karma-44, DSTA-A-1, IC-96113, IS-848-A and ES-3196 were found to be moderately resistant, while the remaining genotypes were susceptible, moderately susceptible, and highly susceptible. When identical genotypes were tested for resistance to phyllody infection, similarly none of the genotypes showed immune or resistant responses, but 8 genotypes *i.e.*, N-32, RT-351, TKG-22, JTA-8, GT-10, King karma-44, DSS-9 and ES-3196 were found to be moderately resistant, while the majority of genotypes were susceptible and moderately susceptible.

Keywords: Genotype, screening, resistant, susceptible, percent disease index

Introduction
Sesame (*Sesamum indicum* L.), belonging to the order Tubiflorae, family *Pedaliaceae*, is mainly grown for its oil which has a pleasant taste and antioxidant properties (Bedigian *et al.*, 1985) [4], accounted for the presence of secondary metabolites. Sesame seed is traditionally consumed directly as well as in confectionaries like cakes, cookies and many other baking products as well as seed cake which is nutritious feed for livestock (Laurenti, 2007) [10]. The seeds contain 50-58 percent of good semi-drying oil, especially rich in oleic and linoleic triglycerides (Qureshi *et al.*, 2003) [17]. It is also a rich source of vitamins (pantothenic acid and vitamin E) and minerals like calcium (1,450 mg/100 g) and phosphorous (570 mg/100 g) (Balasubramaniyan and Palaniappan, 2001) [2].
Low and unreliable yields, shattering led to high production cost and lower returns to the farmers (Murthy *et al.* 1985). Similarly early senescence, photosensitivity and susceptibility to various biotic and abiotic stresses continue to be the major productivity constraints in sesame (Sudhakar and Rangaswamy, 1989) [21]. Among the limiting factors, diseases rank first as the farming community fail to diagnose the disease in time and follow any plant protection measures (Reddy, 2001; Naik *et al.*, 2003) [18, 16]. Sesame crop suffers from many fungal diseases like leaf blight, root rot, damping-off, wilt, charcoal rot, powdery mildew, leaf spot, galls and bacterial diseases namely wilt, blight and spot, viral diseases like leaf curl and phyllody among phytoplasma diseases. Among diseases, the economically important one is *Alternaria* leaf blight caused by *Alternaria sesami* (Kawa.) Mohanty and Behera and *A. alternata* (Chohan, 1978) [6], which cause seed rot, pre- and post-emergence death of seedlings and infect all the above ground parts resulting in considerable loss in yield both qualitatively and quantitatively (Naik *et al*, 2004) [15].
The typical symptoms of *Alternaria sesami* infection start with small greyish spots on the lower leaf surface, progressing to concentric brown spots on the upper surface, eventually forming a distinct target-like pattern with concentric rings at the center (Savitha *et al.*, 2012) [19]. Phyllody, however, is characterized by floral virescence, where flowers transform into leaf-like structures (Yadav, 2020) [24]. Field assessment of several genotypes will aid in the identification of disease-resistant sources. Disease control through host plant resistance is a significant option in all crop development programmes, as use of resistant cultivars in farming is a more straight forward, effective and cost-efficient approach of disease management than chemical methods.

Materials and Methods

The screening of sesame germplasm was conducted at Zonal Agricultural Research Station, Kalaburgi during *Kharif* 2021 to find out the sources of resistance against major foliar diseases like *Alternaria* blight and phyllody by following the infector row technique. The test genotypes were sown during the second week of July with a spacing of 30 cm × 10 cm.

In order to find out the source of resistance, a total 45 germplasm was screened under natural field condition. A susceptible check (Phule til) was also sown after every ten entries. Observations on disease incidence and severity were recorded at 60 days after sowing (DAS). Five plants from each germplasm were randomly selected and based on the reaction of the genotypes against each disease, they were graded in to different categories using specific disease rating scale as mentioned below.

The disease severity of *Alternaria* leaf blight was recorded by following the disease assessment key (0-9 scale) developed by Mayee and Datar (1986) [13] which is described below.

Disease rating scale for *Alternaria* leaf blight

Rating Scale	Disease severity (%)	Disease reaction
0	Healthy	Immune
1	<1 % leaf area covered with spots	Resistant
3	1-10 % leaf area covered with spots	Moderately resistant
5	11-25 % leaf area covered with spots	Moderately susceptible
7	25-50 % leaf area covered with spots	Susceptible
9	>50 % leaf area covered with spots	Highly susceptible

The percent disease index is calculated by using formula given by Wheeler (1969) [23].

$$\text{Percent disease index} = \frac{\text{Sum of numerical ratings}}{\text{Total no. of leaves scored} \times \text{Maximum scale}} \times 100$$

Observation on phyllody was recorded by using standard 0-4 grade (Vanishree *et al*., 2013) [22] disease rating scale as described below.

Disease rating scale for phyllody

Rating Scale	Disease Severity	Percent Disease Incidence
0	Immune (I)	0
1	Resistance (R)	1 to 10
2	Moderately resistant (MR)	10.1 to 25
3	Moderately susceptible (MS)	25.1 to 50
4	Susceptible (S)	> 50

The percent disease incidence of phyllody of sesame is calculated by using the formula:

$$\text{Percent disease incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants examined}} \times 100$$

Results and Discussion

In compared to pesticides, disease management through host plant resistance is an essential choice in the overall crop development programme and is most cheap, inexpensive, and eco-friendly for resource poor farmers. The cost of cultivation of disease/pest resistant cultivars was discovered to be cheaper than that of other approaches. Furthermore, resistant varieties are always one of the greatest options and will go a long way not only in reducing crop loss but also in avoiding fungicidal toxicity and soil pollution.

In the current study, 26 varieties and 19 germplasm of sesame were screened for *Alternaria* leaf blight and phyllody along with susceptible check Phule til during *Kharif* 2021 and classified into distinct disease reaction groups based on disease severity/incidence (Table 1).

Among fourty five sesame entries assessed, the response of the germplasm to *Alternaria* blight revealed that none of the entries were immune and resistant. However, six entries, TKG-22, King karma-44, DSTA-A-1, IC-96113, IS-848-A and ES-3196, were moderately resistant, ten were moderately susceptible, twenty seven were susceptible and the remaining two entries showed highly susceptible reactions with more than 50 percent disease severity (Table 2; Plate 1).

Our findings concur with those of Basavaraj *et al.* (2007) [3], who reported that none of the 73 sesame genotypes were resistant to *Alternaria* leaf blight disease. Similar to this, a total of 172 sesame genotypes were tested by Shekharappa and Patil (2001) [20] against *Alternaria* leaf blight, and they found that none of them were totally immune. However, 3 were resistant and 14 were moderately resistant to *Alternaria* leaf blight.

Aruna *et al*. (2019) [1] screened 34 sesame entries against *Alternaria* leaf blight under natural field condition, 5 accessions IC413200 (NSKMS-149), IC96229, IC96113, IC14136 and IC26309) were grouped under moderate resistant category and 17 accessions *viz*., Gouri, IC96245, IC131546, IC413247 (NSKMS-267) YLM-11, IC132184, IC131565, IC413216 (NSKMS-164), IC413218 (NSKMS-166), Rajeshwari, IC413225 (NSKMS-173), IC413224 (NSKMS-172), IC413233 (NSKMS-221), YLM-17, IC546215 (KSAS-06/97), IC131607, and IC43157 grouped under moderately susceptible category. The remaining 12 accessions *viz*., YLM-66, IC43177, IC132164, VRI-1, IC413184 (NSKMS-275), IC131659, IC23304, IC413297 (NSKMS-244), Hima, Swetha, Madhavi, and IC132240 were found to be susceptible category with more than 50 PDI.

Karuna *et al*. (2014) [9] examined 100 germplasm lines and 59 coordinated trial entries of sunflower against *Alternaria* blight in natural field conditions. They discovered varying degrees of resistance in the germplasm, as disease severity ranged from 15 percent to 30 percent. The germplasm had 78 entries that were somewhat resistant to the illness and four entries that were vulnerable. None of the germplasm entries tested positive for immunity or resistance to the illness. However, the illness rate in susceptible check (Morden) was 38.33 percent. 46 coordinated trial entries were somewhat susceptible, 12 entries were susceptible, and IHT 832 demonstrated resistance reactivity with 5 percent disease severity.

Generally sesame crops sown with later period of *Kharif* susceptible to many diseases. Choudhary *et al*. (2015) [7] studied the influence of dates on sowing and weather

parameters on *Alternaria* leaf spot disease severity and, the study revealed that sesame crop sown on June 5, recorded lowest percentage of *Alternaria* leaf spot disease intensity (19.25 and 26.00 PDI) during *Kharif*, 2002-2003 and 2003-2004. The late sown (August) crop favoured quick disease development and recorded highest disease intensity (60.50 and 70.50 %) during 2002-2003 and 2003-2004, respectively.

During the month of October- November (flowering period), high humidity with dew like rainfall which initiated the blight disease enhancement. Similarly Borkar and Patil (1995) [5] studied weather parameters in relation to development of *Alternaria* leaf blight in Maharashtra and reported temperature of 25.9 °C to 33.7 °C with a relative humidity of 89 to 95 percent favoured disease development. They further reported that the development of disease was influenced by rainfall.

The response of the germplasm to phyllody revealed that none of the entries were immune and resistant. However, eight entries, N-32, RT-351, TKG-22, JTS-8, GT-10, King karma-44, DSS-9 and ES-3196, were moderately resistant, twenty eight were moderately susceptible and the remaining nine entries showed susceptible reactions with more than 50 percent disease incidence (Table 3).

Table 1: Response of sesame germplasm against major foliar diseases

Sl. No	Varieties/ Germplasm	Grade	Remarks	Grade	Remarks
1	Shwetha til	7	S	3	MS
2	Dharvi	7	S	3	MS
3	N-32	7	S	2	MR
4	Piyur	7	S	3	MS
5	Phule til	7	S	3	MS
6	PKVNT-11	7	S	3	MS
7	RT-351	7	S	2	MR
8	TKG-22 (National check)	3	MR	2	MR
9	Krishna	5	MS	3	MS
10	Thilotama	5	MS	4	S
11	B-67	5	MS	3	MS
	Check(S) – Phule til	9	HS	4	S
12	Chandana	7	S	3	MS
13	CUMS-17	7	S	3	MS
14	JTS-8 (Zonal check)	5	S	2	MR
15	Rajeshwari	7	S	3	MS
16	GT-10	5	MS	2	MR
17	Kanak	5	MS	3	MS
18	GT-4	9	HS	3	MS
19	Rama	5	MS	3	MS
20	GT-2	7	S	4	S
21	King karma-44	3	MR	2	MR
22	DSS-9	7	S	2	MR
	Check(S) – Phule til	7	S	4	S
23	GRT-8328	7	S	4	S
24	CT-35	7	S	3	MS
25	DORG-122	5	MS	3	MS
26	CT-46	7	S	3	MS
27	DSTA-1-A	3	MR	4	S
28	CT-47	5	MS	3	MS
29	DORG-135-103	7	S	3	MS
30	DSC-560	5	MS	3	MS
31	CT-50	7	S	3	MS
32	IC-131607	7	S	3	MS
	Check (S)– Phule til	9	HS	4	S
33	GRT-8359-1	7	S	4	S
34	IC-96113	3	MR	4	S
35	IS-848-A	3	MR	3	MS
36	H-33	7	S	3	MS
37	EC-3310427	7	S	3	MS
38	ES-3196	3	MR	2	MR
39	GT-8329	7	S	3	MS
40	IS-113-A	7	S	3	MS
41	IC-204500	7	S	4	S
	Check (S)– Phule til	9	HS	4	S
42	Entane ellu	7	S	3	MS
43	Chitt ellu	7	S	4	S
	Check (S) – Phule til	7	S	4	S
44	Bidar local	7	S	3	MS
45	Koppal local	7	S	4	S

Table 2: Categorisation of sesame germplasm based on their reaction against *Alternaria* leaf blight of sesame

Numerical rating	Disease reaction	Germplasm/ varieties
0	Immune (I)	None
1	Resistant (R)	None
3	Moderately Resistant (MR)	TKG-22, King karma-44, DSTA-A-1, IC-96113, IS-848-A, ES-3196
5	Moderately susceptible (MS)	Krishna, Thilotama, B-67, GT-10, Kanak, Rama, DORG-122, CT-47, JTS-8, DSC-560
7	Susceptible (S)	Shwetha til, Dharvi, N-32, Piyur, PKVNT-11, RT-351, Chandana, CUMS-17, Rajeshwari, GRT-8328, CT-35, CT-46, DORG-135-103, CT-50, H-33, GT-8329, IS-113-A, IC-204500, Entane ellu, Chitt ellu, Koppal local, GT-2, DSS-9, IC-131607, GRT-8359-1, EC-3310427, Bidar local
9	Highly susceptible (HS)	Phule til, GT-4

MR: Moderately resistant, MS: Moderately susceptible, S: susceptible, HS: Highly susceptible.

Table 3: Categorisation of sesame germplasm based on their reaction against phyllody of sesame

Numerical rating	Disease reaction	Germplasm/ varieties
0	Immune (I)	None
1	Resistant (R)	None
2	Moderately Resistant (MR)	N-32, RT-351, TKG-22, JTS-8, GT-10, King karma-44, DSS-9, ES-3196
3	Moderately susceptible (MS)	Shwetha til, Dharvi, Piyur, Phule til, PKVNT-11, Krishna, B-67, Chandana, CUMS-17, Kanak, Rajeshwari, GT-10, Rama, CT-35, DORG-122, CT-46, CT-47, DORG-135-103, DSC-560, CT-50, IC- 131607, IS-848-A, H-33, EC-3310427, GT-8329, IS-113-A, Entane ellu, Bidar local
4	Susceptible (S)	Thilotama, GT-2, GRT-8328, DSTA-1-A, GRT-8359-1, IC-96113, IC-204500, Chitt ellu, Koppal local, Phule til

MR: Moderately resistant, MS: Moderately susceptible, S: susceptible

Plate 1: Field view of screening plot of major foliar diseases of sesame

Our present findings are in accordance with Magar *et al.* (2022) [11] who investigated total 32 varieties of sesame and were screened for resistance to phyllody disease under natural field condition. Out of all the varieties under natural epiphytotic condition none of varieties was found immune for disease. Varieties TBS-05, TBS-09, TBS-02, Sweta, KMR-69, TKG-22 and Pragati were resistant, TBS-06, TBS-07, GT-10, GT-01, IVT-17-03, IVT-1705, IVT-17-18, AVT-06, TBS-08, AKT101, Prachi and Latur local were moderately resistant and IVT-17-07, AVT-17-12 was susceptible to sesame phyllody disease.

A total of 43 germplasm lines were screened against phyllody under field condition where, Navile-1 was used as susceptible check. Three genotypes *viz*., KAU-05-2- 12, PC-14-.2 and Kanakapurra local showed resistant reaction, 27 lines *viz*., DS-28, RT-363, CUHY-.57, AT-255, DS-.23, DS10, NIC-.16236, AKT 101, RT-54, Amrit, AKT-.64, RT-125, TMV-3, TKG 306, ST-9-2, ES-48, Chandana, ES-8779-.4, IS 294, E-8, DS-1, GT-1, DS-9, K-.15284, RT-11, EC-303419 and Gulbarga showed moderately resistant reaction, 13 lines *viz.*, JCS-.2464, AT-249, PC-14-1, TKG-22, AT-282, GT-.10, DS-19, CUMS-17, JLS-301-24, AT-231, DS-5, Local variety (black). And DSS-9 showed susceptible reaction (Mahadevaprasad *et al.*, 2017) [12].

Conclusion

Among 45 genotypes screened, six genotypes *i.e.*, TKG-22, King karma-44, DSTA-A-1, IC-96113, IS-848-A, ES-3196) and eight genotypes *i.e.*, N-32, RT-351, TKG-22, JTA-8, GT-10, King karma-44, DSS-9, ES-3196 were found to be moderately resistant against *Alternaria* leaf blight and phyllody respectively.

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