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## Evaluation of sunflower genotypes for *Alternaria* disease resistance to identify the resistant genotypes

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**Abstract**

*Alternaria* leaf spot caused by *Alternaria helianthi* has been considered as economically important disease. The present study was carried out to identify resistant or moderately resistant genotypes against the *Alternaria* leaf spot in field screening and artificial screening. Out of 115 genotypes screened in field 31 genotypes were moderately resistant, 60 genotypes were susceptible whereas 24 genotypes were highly susceptible. Resistance to *Alternaria* is reported to exhibit differential reactions with the environment, hence field screening alone is insufficient while choosing genotypes for further resistance breeding programme. Therefore genotypes which showed moderate resistance (31) and high susceptibility (24) were screened artificially, along with 4 checks. Moderate resistant reaction for *Alternaria* leaf blight disease was observed in 1B, COSF 7B, CSFI 5083, CSFI 5181, CSFI 5213, CSFI 5276, CSFI 5292, CSFI 5336, POP 449-1-2-4, CSFI 13034, CSFI 13043 and TNHSF 239-68-1-1-1, when artificially screened. These genotypes may be evaluated in hot spot areas along with the resistant check to confirm their disease reaction. Hence these genotypes are considered as potential parents for *Alternaria* resistance breeding programme.

**Keywords:** *Alternaria*, sunflower, screening, leaf spot

**Introduction**

Sunflower (*Helianthus annuus* L.) is termed as the "Golden girl of American Agriculture" planted earlier for aesthetic value and apiary. It has now become the third major source of edible oil in the world after soybean and groundnut. The sunflower crop is native to North America, also grown extensively in Russia, Argentina, France, Spain, USA and India. Selection for high oil content in Russia began in 1860 and was largely responsible for increasing oil content from 28 per cent to almost 50 per cent. Sunflower competes in the world oilseed complex with other major oilseeds viz., soybean, groundnut and rapeseed. It is successfully grown over a widely scattered geographical area and considered as a crop adapted to a wide range of environmental conditions (Ekin *et al.* 2005) [3]. Sunflower holds great promise because of its short duration, photo-insensitivity and wider adaptability and drought tolerance. Its adaptability to a wide range of soil and climatic conditions, which makes its cultivation possible during any part of the year in the tropical and sub tropical regions of the country (Reddy and Kumar, 1996) [12]. It is a rich source of edible oil (40 to 45 per cent) and is considered as good from health point of view due to high concentration of Poly Unsaturated Fatty Acids (PUFA) (55 to 60 per cent linoleic acid and 25-30 per cent oleic acid) which are known to reduce the risk of coronary diseases by regulating the cholesterol content in blood plasma (Mallik *et al.* 2020) [7].

Although sunflower crop has the yield potential of 2.0 to 2.5 tonnes/ha under favourable conditions, the average productivity level in India is very low. The lower yield level of sunflower is mainly due to several biotic and abiotic factors (Mallik *et al.* 2016) [8]. Among these, susceptibility to disease is considered to be one of the major constraints. Kolte and Mukhopadhyay (1985) observed that the crop suffers from various diseases incited by fungi, bacteria, virus and phytoplasma.

Gulya and Masirevic (1991) [4] listed 80 pathogens causing diseases in sunflower. *Alternaria* leaf spot, powdery mildew and necrosis disease have become most important limiting factors of productivity in sunflower. Among these, *Alternaria* leaf spot caused by *Alternaria helianthi*

has been considered as economically important disease. It affects most of the commercial varieties under present cultivation and it has been reported from different parts of the world. *Alternaria* leaf blight is known to cause more than 80 per cent of the yield loss under severe epiphytotic conditions (Hiremath *et al.*, 1990) [5]. To date no complete resistance against *Alternaria* is available in cultivated sunflower or any related germplasm even though the differences in susceptibility exist. Breeding for resistance to *Alternaria* leaf spot faces the challenge of a gene pool containing only moderate levels of resistance. There is a strong need to identify genotypes resistant to *Alternaria* isolates of the geographical region and identify potential hybrid with genes for resistance/tolerance to *Alternaria helianthi*.

### Materials and Methods

The seed material of 115 genotypes for the field experiments were obtained from the Sunflower Unit at the Department of Oilseeds, Tamil Nadu Agricultural University (TNAU), Coimbatore (Table 1). The field experiments were carried out at Department of Oilseeds, TNAU, Coimbatore during *kharif*, 2014. The trial was conducted with two replications in a randomized block design. In each replication, each entry was raised in 4m row, adopting a spacing of 60 cm between the rows and 30 cm between the plants. Normal agronomic practices were followed under irrigated condition.

*Alternaria* disease was scored using 0 to 9 scale as suggested by Mayee and Datar (1986) [9] (Table 2) on each plants in each entry at 80 days after sowing. Using average of all scores, the genotypes were classified using average of all scores into following six groups given by Nagaraju *et al.* (1992) [10].

0	-	Immune
1-2.0	-	Highly resistant
2.1 - 5.0	-	Resistant
5.1 – 7.0	-	Moderately resistant
7.1 – 8.0	-	Susceptible
8.1 – 9.0	-	Highly susceptible

Further, these observations were converted to per cent disease index (PDI) using following formula (Wheeler, 1969) [13].

$$PDI = \frac{\text{Sum of disease ratings}}{\text{Number of plants rated}} \times \frac{100}{\text{Highest score}}$$

On the basis of result of field screening, 31 moderate resistant genotypes, 24 highly susceptible genotypes and 4 checks were taken for artificial screening. The 59 genotypes were sown in 30 rings in wild species garden, Centre for Plant Breeding and Genetics (CPBG), with two replications in a randomized block design (RBD). Four genotypes were sown in each ring, with four plants of each genotype.

The fungus *Alternaria helianthi* was isolated from infected sunflower leaf. The culture was purified and multiplied in

potato dextrose agar. The 10 days old culture is used for the preparation of suspension culture and filtered through muslin cloth. The concentration of conidial suspension had been made to 10<sup>6</sup> conidia/ml. The conidial suspension had been sprayed uniformly on the leaves of 30 days old plants using sprayer. The inoculated plants were watered and covered with plastic covers for 1-2 days, to maintain humidity. The disease incidence was recorded after 10 days of the inoculation based on the above mentioned standard scale and PDI is calculated.

### Results and Discussion

*Alternaria* leaf blight caused by *Alternaria helianthi* is a widespread disease in India assuming severity when the crop is grown during rainy season causing yield loss upto 80 per cent (Balasubramanyam and Kolte, 1980a and 1980b and Hiremath *et al.*, 1990) [1, 2, 5]. The disease has remained as a major threat to sunflower production for over three decades. The earlier efforts have gone in vain due to non-availability of stable resistant sources in the cultivated germplasm. However, several efforts have been made earlier to screen the germplasm against *Alternaria* by different workers but the reports indicated susceptible to moderate degree of tolerance (Patil, 2011) [11].

All the 115 genotypes were screened for *Alternaria* leaf spot severity at field condition. Out of 115 genotypes screened, none of them were found to be immune or resistant to *Alternaria* leaf blight. Among the genotypes, 31 genotypes showed moderate resistance, 60 genotypes as susceptible and 24 genotypes as highly susceptible (Table 3). The moderate resistant genotypes were 17B, 1B, ARM 243B, COSF 2B, COSF 7B, CSFI 5019, CSFI 5040, CSFI 5062, CSFI 5083, CSFI 5181, CSFI 5194, CSFI 5205, CSFI 5213, CSFI 5216, CSFI 5232, CSFI 5260, CSFI 5276, CSFI 5292, CSFI 5334, CSFI 5335, CSFI 5336, M 1014-1, M 1014-4, POP 440-1-2-1, POP 449-1-2-2, POP 449-1-2-3, POP 449-1-2-4, POP 449-2-1-1, RPOP 24-5-3, RPOP 26-3-5 and TNHSF 239-68-1-1-1. The work carried out so far in detection of *Alternaria* resistance is quite meagre in sunflower in view of lack of resistance in the entire world collections. Further, resistance to *Alternaria* is reported to exhibit differential reactions with the environment (Nagaraju *et al.*, 1992) [10]. Due to this field screening alone is insufficient while choosing genotypes for further resistance breeding programme. Hence, the genotypes which showed moderate resistance (31) and high susceptibility (24) were screened artificially, along with 4 checks. The PDI and resistance reaction of the 55 genotypes along with four checks are presented in Table 4. Out of 59 genotypes, 12 genotypes showed moderate resistance, 25 genotypes were susceptible and 22 genotypes were highly susceptible. All checks showed susceptible reaction. The moderate resistance genotypes were 1B, COSF 7B, CSFI 5083, CSFI 5181, CSFI 5213, CSFI 5276, CSFI 5292, CSFI 5336, POP 449-1-2-4, RPOP 24-5-3, RPOP 26-3-5 and TNHSF 239-68-1-1-1. All these genotypes showed moderate resistance in field screening.

**Table 1:** List of genotypes used in the research

Sl. No.	Genotypes	Sl. No.	Genotypes	Sl. No.	Genotypes
1	17B	40	CSFI 5152	79	CSFI 5398
2	1B	41	CSFI 5177	80	CSFI 5401
3	207 DS B	42	CSFI 5181	81	CSFI 5406
4	207B	43	CSFI 5190	82	CSFI 5411
5	234B	44	CSFI 5194	83	CSFI 8002
6	300B	45	CSFI 5205	84	CSFI 99

7	400B	46	CSFI 5210	85	IR 3
8	607B	47	CSFI 5213	86	M 1014-1
9	60B	48	CSFI 5216	87	M 1014-3
10	821B	49	CSFI 5219	88	M 1014-4
11	850B	50	CSFI 5223	89	POP 440-1-2-1
12	852B	51	CSFI 5232	90	POP 448-3-1-2
13	86B	52	CSFI 5246	91	POP 449-1-2-1
14	ARM 243B	53	CSFI 5254	92	POP 449-1-2-2
15	CO 4	54	CSFI 5260	93	POP 449-1-2-3
16	COSF 1B	55	CSFI 5276	94	POP 449-1-2-4
17	COSF 2B	56	CSFI 5286	95	POP 449-2-1-1
18	COSF 3B	57	CSFI 5287	96	POP 449-2-1-2
19	COSF 5B	58	CSFI 5288	97	POP 449-2-1-3
20	COSF 6B	59	CSFI 5291	98	POP 449-2-1-4
21	COSF 7B	60	CSFI 5292	99	CSFI 13021
22	COSFV 5	61	CSFI 5293	100	CSFI 13022
23	CSFI 5019	62	CSFI 5298	101	CSFI 13023
24	CSFI 5021	63	CSFI 5307	102	CSFI 13069
25	CSFI 5040	64	CSFI 5330	103	CSFI 13071
26	CSFI 5055	65	CSFI 5331	104	CSFI 13024
27	CSFI 5062	66	CSFI 5334	105	CSFI 13028
28	CSFI 5075	67	CSFI 5335	106	CSFI 13033
29	CSFI 5078	68	CSFI 5336	107	CSFI 13034
30	CSFI 5082	69	CSFI 5341	108	CSFI 13035
31	CSFI 5083	70	CSFI 5347	109	CSFI 13043
32	CSFI 5084	71	CSFI 5373	110	CSFI 13001
33	CSFI 5086	72	CSFI 5377	111	CSFI 13002
34	CSFI 5090	73	CSFI 5381	112	CSFI 13003
35	CSFI 5092	74	CSFI 5387	113	CSFI 13004
36	CSFI 5124	75	CSFI 5388	114	CSFI 13005
37	CSFI 5125	76	CSFI 5389	115	TNHSF 239-68-1-1-1
38	CSFI 5133	77	CSFI 5390		
39	CSFI 5140	78	CSFI 5393		

**Table 2:** Disease scoring scale for *Alternaria* leaf blight (Mayee and Datar, 1986)<sup>[9]</sup>.

Rating	Description	Reaction
0	No symptoms on leaf	Immune
1	Small circular; scattered; brown spots covering 1% leaf area	Highly resistant
3	Spots enlarging dark brown in colour covering 1 to 10% leaf area and infection in lower most leaves	Resistant
5	Spots enlarging; dark brown in colour covering 11% to 25% leaf area and infection ½ of the plant	Moderately resistant/susceptible
7	Spots dark brown coalescing; occupying 26 to 50% leaf area and 2/3 <sup>rd</sup> of the plant	Susceptible
9	Spots uniformly dark brown coalescing; covering 50% or more leaf area; severe infection on all leaves and infected to greater degree	Highly susceptible

**Table 3:** PDI and disease reaction of the genotypes in natural incidence

Genotypes	PDI (%)	Disease reaction
CSFI 5260	14.27	MR
ARM 243B	14.35	MR
CSFI 5019	14.64	MR
CSFI 5335	15.65	MR
CSFI 5232	15.72	MR
M 1014-4	16.10	MR
17B	16.22	MR
CSFI 5292	16.26	MR
CSFI 5213	16.45	MR
COSF 2B	16.95	MR
1B	18.58	MR
TNHSF 239-68-1-1-1	18.71	MR
CSFI 5040	19.68	MR
M 1014-1	19.82	MR
POP 449-1-2-3	20.20	MR
CSFI 5205	21.39	MR
CSFI 13043	21.41	MR
CSFI 5062	21.80	MR
CSFI 5336	21.96	MR
CSFI 5194	22.07	MR
CSFI 5334	22.61	MR
CSFI 5083	22.77	MR

CSFI 5216	23.38	MR
POP 449-1-2-4	23.72	MR
CSFI 13034	23.92	MR
COSF 7B	24.09	MR
CSFI 5276	24.17	MR
CSFI 5181	24.33	MR
POP 440-1-2-1	24.45	MR
POP 449-1-2-2	24.80	MR
POP 449-2-1-1	24.99	MR
CSFI 5092	25.05	S
CSFI 5291	25.18	S
CSFI 5084	26.00	S
CSFI 5086	26.25	S
CSFI 5246	26.67	S
CO 4	27.08	S
400B	27.53	S
CSFI 13024	27.53	S
CSFI 5021	28.75	S
CSFI 5254	29.06	S
CSFI 5288	29.36	S
CSFI 13035	30.00	S
POP 449-2-1-2	30.03	S
M 1014-3	30.39	S
CSFI 5223	30.40	S
POP 449-1-2-1	30.53	S
COSF 3B	31.30	S
COSFV 5	31.60	S
CSFI 5298	32.33	S
CSFI 5210	32.56	S
CSFI 5133	32.63	S
CSFI 5090	32.87	S
CSFI 5406	32.90	S
86B	33.86	S
CSFI 5341	36.95	S
CSFI 13071	37.17	S
CSFI 13033	37.70	S
CSFI 5330	37.71	S
CSFI 5411	37.87	S
CSFI 5387	37.89	S
POP 449-2-1-4	37.98	S
CSFI 5293	38.67	S
CSFI 5078	40.00	S
CSFI 13022	40.65	S
821B	40.98	S
CSFI 5398	41.01	S
CSFI 13003	41.67	S
207B	42.42	S
POP 449-2-1-3	42.44	S
852B	42.45	S
300B	42.51	S
CSFI 5377	43.18	S
CSFI 5307	43.45	S
CSFI 5390	43.58	S
COSF 5B	44.00	S
CSFI 5152	44.17	S
CSFI 5389	44.21	S
CSFI 13001	44.45	S
CSFI 5286	45.00	S
COSF 1B	45.16	S
CSFI 5177	46.35	S
CSFI 13004	46.75	S
CSFI 5190	46.83	S
CSFI 5055	47.55	S
CSFI 5219	47.73	S
CSFI 5331	48.64	S
CSFI 5140	49.34	S
IR 3	49.66	S
CSFI 8002	50.58	HS
CSFI 5125	50.67	HS

CSFI 5347	51.37	HS
CSFI 13028	53.15	HS
CSFI 13002	53.59	HS
CSFI 5124	54.17	HS
CSFI 13005	54.31	HS
CSFI 5075	55.28	HS
CSFI 5082	55.65	HS
CSFI 5401	56.37	HS
CSFI 13069	57.70	HS
CSFI 5393	58.04	HS
CSFI 5287	58.06	HS
POP 448-3-1-2	58.42	HS
234B	59.17	HS
CSFI 99	60.18	HS
850B	61.00	HS
COSF 6B	63.61	HS
CSFI 13021	65.75	HS
CSFI 5388	67.02	HS
CSFI 13023	67.68	HS
CSFI 5381	71.35	HS
207 DS B	73.06	HS
60B	74.38	HS
607B	78.38	HS
CSFI 5373	90.12	HS

MR-Moderately resistance

S-Susceptible

HS-Highly susceptible

**Table 4:** Comparison of PDI and disease reaction of the genotypes in field condition and artificial screening

Genotypes	PDI (%) in field condition	Disease reaction in field condition	PDI (%) in Artificial screening	Disease reaction in artificial screening
CSFI 5292	16.26	MR	21.67	MR
POP 449-1-2-4	23.72	MR	21.94	MR
CSFI 5083	22.77	MR	22.22	MR
CSFI 13043	21.41	MR	22.50	MR
CSFI 5213	16.45	MR	22.78	MR
CSFI 13034	23.92	MR	22.78	MR
TNHSF 239-68-1-1-1	18.71	MR	22.78	MR
1B	18.58	MR	23.06	MR
CSFI 5276	24.17	MR	23.64	MR
CSFI 5181	24.33	MR	23.89	MR
COSF 7B	24.09	MR	24.17	MR
CSFI 5336	21.96	MR	24.72	MR
POP 449-1-2-3	20.20	MR	26.24	S
17B	16.22	MR	30.00	S
CSFI 5232	15.72	MR	30.28	S
COSF 2B	16.95	MR	30.56	S
CSFI 5260	14.27	MR	30.56	S
POP 449-1-2-2	24.80	MR	30.67	S
POP 449-2-1-1	24.99	MR	31.11	S
CSFI 5040	19.68	MR	32.22	S
CSFI 5019	14.64	MR	33.89	S
CSFI 5216	23.38	MR	35.00	S
CSFI 5062	21.80	MR	35.19	S
ARM 243B	14.35	MR	35.28	S
POP 448-3-1-2	58.42	HS	36.67	S
CSFI 5194	22.07	MR	38.89	S
CSFI 5287	58.06	HS	42.78	S
CSFI 5335	15.65	MR	43.89	S
POP 440-1-2-1	24.45	MR	44.44	S
M 1014-1	19.82	MR	44.72	S
M 1014-4	16.10	MR	45.00	S
CSFI 5334	22.61	MR	45.56	S
CSFI 13002	53.59	HS	46.11	S
CSFI 5075	55.28	HS	53.33	HS
CSFI 5347	51.37	HS	54.10	HS
CSFI 5401	56.37	HS	55.00	HS
CSFI 13028	53.15	HS	55.00	HS
CSFI 5082	55.65	HS	57.22	HS

Table 4: Contd....

Genotypes	PDI (%) in field condition	Disease reaction in field condition	PDI (%) in Artificial screening	Disease reaction in Artificial screening
CSFI 5205	21.39	MR	58.33	HS
CSFI 13005	54.31	HS	58.33	HS
CSFI 13069	57.70	HS	58.38	HS
234B	59.17	HS	58.89	HS
CSFI 99	60.18	HS	60.56	HS
CSFI 5393	58.04	HS	61.11	HS
CSFI 5124	54.17	HS	62.22	HS
850B	61.00	HS	63.33	HS
CSFI 5388	67.02	HS	66.11	HS
CSFI 13021	65.75	HS	66.11	HS
60B	74.38	HS	66.67	HS
COSF 6B	63.61	HS	69.44	HS
CSFI 13023	67.68	HS	69.44	HS
607B	78.38	HS	71.11	HS
207 DS B	73.06	HS	72.22	HS
CSFI 5381	71.35	HS	72.50	HS
CSFI 5373	90.12	HS	85.00	HS
Sunbred 275 (check)	-	-	28.89	S
CO 2Hybrid (check)	-	-	44.44	S
COSFV 5 (check)	31.60	S	45.56	S
CO 4 (check)	27.08	S	46.11	S

MR-Moderately resistance

S-Susceptible

HS-Highly susceptible

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