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Identification of Resistant Sources of Different Cultivars of Castor Against *Macrophomina Phaseolina*

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ABSTRACT

Root rot caused by *Macrophomina phaseolina* is one of the most important disease of castor causes significant yield losses. Therefore, the current study was carried out in a greenhouse at ICAR-Indian Institute of Oilseeds Research Rajendranagar, Hyderabad to screen various parental lines/advanced breeding material for their resistance against castor root rot that can be exploited in cultivar improvement. Fourty eight parental lines/advanced breeding material of castor were evaluated in order to discover new and improved sources of resistance against root rot under sick pot conditions. Out of that, parental line *i e.,* ICS-415 was found to be resistant (d• 10 %) to root rot infection. Ten were found to be moderately resistant (11-20 %) another 10 parental lines were moderately susceptible (20-30 %), twenty one were found to be susceptible (30-50 %) and remaining were highly susceptible (> 50 %) to the root rot disease. Root rot infection affected all of the parental lines to some extent, and none of the entries were completely free from the disease incidence.

Keywords: *Castor (Ricinus communis L.), Parental lines/advanced breeding material, Root rot and Screening*

Castor, *Ricinus communis* L. (Euphorbiaceae, 2n=2x=20), is an important oilseed crop cultivated worldwide for its versatile uses and economic significance. It is non edible oilseed crop cultivated for centuries throughout tropics and warm temperature regions due to its high oil content and various industrial applications (Zarai *et al*., 2012). This crop is indigenous to the South-Eastern Mediterranean Basin, Eastern Africa, and India, but is widespread throughout tropical regions. In India, castor cultivation is concentrated in the states of Gujarat, Rajasthan, Andhra Pradesh, Tamil Nadu, Karnataka and Odisha, together adding to more than 90 per cent of total domestic production.

Castor oil stands unique among the vegetable oils because of the presence of ricinoleic acid, a hydroxyl fatty acid contributing to high specific gravity and thickness compared to other vegetable oils, with a number of uses. The oil content in castor seed ranges from 45-50 per cent in different varieties (Kaur *et al*., 2020).

Castor being a hardy crop, is prone to many pathogen infections. Among different diseases in castor, root rot caused by *M. phaseolina* is one of important pathogen. It is a devastating disease in dry lands. *M. phaseolina* causes different symptoms on castor *viz*., seedling blight, dieback, stem blight, collar rot, root rot and twig blight (Moses and Reddy, 1987). The fungus is soil borne and survives in soil for long periods in the form of sclerotia. It survives in the stem and root system of the infected plants. Crop debris play major role in initiation of infection in the field. Pycnidia which are produced on aerial plant parts help in the secondary spread (Maiti and Raoof, 1984). Therefore, it becomes necessary to understand the severity of the disease noting to so many variations in its cultivation practices and factors influencing the disease development. The aim of the present paper is to screen parental lines/advanced breeding lines of castor for identification of resistant sources against root rot under pot culture conditions.

MATERIAL AND METHODS

A total of 48 parental lines with GCH-4 as susceptible check and JI-449 as resistant check were evaluated against root rot by sick pot culture method under net house conditions. Pots were maintained containing sterilized soil and culture mix under net house conditions. Ten seedlings were maintained for each accession by sowing ten seeds per pot and three replications were maintained. Control plants were maintained without pathogen inoculation. The germinated seedlings were recorded 10 days after sowing and plants infected with root rot recorded at an interval of 7 days upto 45 days after sowing, percentage of root rot infected plants were recorded. The pots were watered daily to maintain the humidity in pots. Parental lines were listed in Table 1. Disease scale in Table 2

The data obtained from the experiment was statistically analysed following the standard procedures.

RESULTS AND DISCUSSION

Out of 48 parental lines screened against *M. phaseolina*, none of the lines showed complete resistance to root rot incidence. ICS-415 was found to be resistant with 10.7% of root rot incidence. Ten parental lines namely 2025-1, ICS-411, 2066, ICS-418, ICS-420, 2256-1, 2412-1, SPT.NO-7, SPT.NO-59 and SPT.NO-131 were found to be moderately resistant with 15.0, 16.7, 20.0, 17.4, 20.0, 20.0, 14.3, 12.5, 14.8 and 18.5 % root rot incidence, respectively. Ten parental lines namely ICS-417, ICS-421, ICS-424, SPT.NO-11, SPT.NO-48, SPT.NO-164-2, 15R2NSP, 15G2SP, 13G3NSP and 14G2NSP were found to be moderately susceptible with 24.0, 30.0, 22.7, 33.3, 26.1, 26.3, 27.3, 30.8, 21.1 and 25.0 % root rot incidence, respectively.

Table 1. List of parental lines used for screening against *M. phaseolina* infecting castor

S. No	Cultivars	S.No.	Cultivars
1	1931-1	26	SPT.NO-107
2	ICS-406	27	SPT.NO-108
3	2025-1	28	SPT.NO-113
4	2049-1	29	SPT.NO-113/A
5	ICS-411	30	SPT.NO-115
6	2066	31	SPT.NO-124
7	ICS-413	32	SPT.NO-130
8	ICS-415	33	SPT.NO-131
9	ICS-416	34	SPT.NO-155-1
10	ICS-417	35	SPT.N0-155-2
11	ICS-418	36	SPT.N0-157-1
12	ICS-420	37	SPT.N0-160
13	ICS-421	38	SPT.N0-161
14	ICS-422	39	SPT.N0-164-2
15	2256-1	40	15R2NSP
16	ICS-424	41	13R2NSP
17	2402-1	42	15G2SP
18	2412-1	43	K22-38
19	SPT.NO-7	44	15G3NSP
20	SPT.NO-11	45	K22-37
21	SPT.NO-48	46	K22-46
22	SPT.NO-59	47	K22-49
23	SPT.NO-68	48	14G2NSP
24	SPT.NO-94	49	Resistant (JI-449)
25	SPT.NO-104	50	Susceptible(GCH-4)

Twenty one parental lines *viz.,* 1931-1, ICS-406, 2049-1, ICS-413, ICS-416, ICS-422, 2402-1, SPT.NO-104, SPT.NO-108, SPT.NO-115, SPT.NO-124, SPT.NO-130, SPT.NO-155-1, SPT.NO-155-2, SPT.NO-157-1, SPT.NO-160, SPT.NO-161, K22-38, K22-37, K22-46 and K22-49 were found to be susceptible with 31.6 to 50.0% of root rot incidence. Remaining parental lines *viz.,* SPT.NO-68, SPT.NO-94, SPT.NO-107, SPT.NO-113, SPT.NO-113/A and 13R2NSP were found to be highly susceptible with 58.8 to 88.5 % root rot incidence (Table 3 and Table 4)

Thiyagu *et al*. (2007) evaluated 15 parents and their F1's against *M. phaseolina,* causing charcoal rot of sesame under sick pot conditions and reported that three genotypes *viz.,* ORM 7, ORM 14 and ORM 17 as resistant to root rot disease with minimum disease incidence. Similarly, Parmer *et al.* (2019) conducted a study to screen thirty-two genotypes/varieties of castor for locating new and better sources of resistance against root rot under sick plot conditions and revealed that none of the entries were completely free from root rot infection and all the genotypes were more or less affected by the disease. Siddique *et al.* (2021) screened twenty-two sunflower germplasms against *M. phaseolina*. None of the germplasm was diseasefree; four were found to be resistant, five moderately resistant, six moderately susceptible, five susceptible, and two highly susceptible. The above results were similar to the findings of the present study.

Table 2. Disease rating scale for root rot of castor

Disease scale	Percent Infection (%)	Category
0	No root rot symptoms	Highly resistant
1	? 10 % root rot incidence	Resistant
3	11-20 % root rot incidence	Moderately resistant
5	21-30 % root rot incidence	Moderately susceptible
7	31-50 % root rot incidence	Susceptible
9	> 51 % root rot incidence	Highly susceptible

Source: Mayee and Datar (1986).

Table 3. Screening of parental lines against root rot disease *M. phaseolina* by sick pot method

s	Cultivars	Plant stand	Root rot disease incidence (%) at 45 DAS	Disease Reaction	Disease scale
1	1931-1	22	50 (45.0)*	S	7
2	ICS-406	20	45 -42.1	S	7
3	2025-1	20	15 -22.8	MR	3
4	2049-1	24	33.3 -35.3	S	7
5	ICS-411	24	16.7 -24.1	MR	3
6	2066	25	20 -26.6	MR	3
7	ICS-413	21	33.3 -35.2	S	7

8	**ICS-415**	**28**	**10.7 -19.1**	**R**	**1**
9	**ICS-416**	**15**	**46.7 -43.1**	**S**	**7**
10	**ICS-417**	**24**	**24 -29.3**	**MS**	**3**
11	**ICS-418**	**23**	**17.4 -24.6**	**MR**	**3**
12	**ICS-420**	**20**	**20 -26.6**	**MR**	**3**
13	**ICS-421**	**20**	**30 -33.2**	**MS**	**5**
14	**ICS-422**	**12**	**33.3 -35.2**	**S**	**7**
15	**2256-1**	**15**	**20 -26.5**	**MR**	**3**
16	**ICS-424**	**22**	**22.7 -28.4**	**MS**	**5**
17	**2402-1**	**27**	**44.4 -41.8**	**S**	**7**
18	**2412-1**	**21**	**14.3 -22.2**	**MR**	**3**
19	**SPT.NO-7**	**16**	**12.5 -20.7**	**MR**	**3**
20	**SPT.NO-11**	**18**	**33.3 -35.2**	**MS**	**7**
21	**SPT.NO-48**	**23**	**26.1 -30.7**	**MS**	**5**
22	**SPT.NO-59**	**27**	**14.8 -22.6**	**MR**	**3**
23	**SPT.NO-68**	**25**	**60 -50.7**	**HS**	**9**
24	**SPT.NO-94**	**26**	**88.5 -70.2**	**HS**	**9**
25	**SPT.NO-104**	**20**	**40 -39.2**	**S**	**7**
26	**SPT.NO-107**	**22**	**63.6 -52.9**	**HS**	**9**
27	**SPT.NO-108**	**21**	**42.9 -40.9**	**S**	**7**
28	**SPT.NO-113**	**24**	**58.3 -49.7**	**HS**	**9**
29	**SPT.NO-113/A**	**22**	**68.2 -55.7**	**HS**	**9**

30	SPT.NO-115	26	50 -45	S	7
31	SPT.NO-124	24	41.7 -40.2	S	7
32	SPT.NO-130	23	39.1 -38.7	S	7
33	SPT.NO-131	27	18.5 -25.4	MR	3
34	SPT.NO-155-1	15	40 -39.2	S	7
35	SPT.N0-155-2	25	44 -41.5	S	7
36	SPT.N0-157-1	28	39.3 -38.8	S	7
37	SPT.N0-160	22	45.5 -42.4	S	7
38	SPT.N0-161	17	47.1 -43.3	S	7
39	SPT.N0-164-2	19	26.3 -30.8	MS	5
40	15R2NSP	22	27.3 -31.5	MS	5
41	13R2NSP	10	60 -50.7	HS	9
42	15G2SP	26	30.8 -33.7	MS	5
43	K22-38	20	50 -45	S	7
44	15G3NSP	19	21.1 -27.3	MS	5
45	K22-37	17	41.2 -39.9	S	7
46	K22-46	14	35.7 -36.7	S	7
47	K22-49	19	31.6 -34.2	S	7
48	14G2NSP	20	25 -30	MS	5
49	Resistant (JI-449)	26	11.5 -19.8	MR	3
50	Susceptible (GCH-4)	23	100 -89.7	HS	9
	SE(m)±		0.483		
	C.D. (p?0.05)		1.358		
	CV (%)		2.286		

***Figures in parenthesis are arc sine transformed values**

RESISTANT (ICS-

Moderately Resistant (SPT.NO-7)

Moderately Resistant

Moderately Resistant (SPT.NO-59)

Moderately Resistant (2025-1)

Moderately Resistant (ICS-411)

Moderately Resistant

Moderately Resistant

Moderately Resistant (2256-1)

Moderately Resistant (ICS-420)

Moderately Resistant (2066)

Plate 1. Resistant and moderately resistant cultivars

Table 4. Disease reaction of parental lines

Disease Reaction	Parental lines	No. of entries
Highly resistant	-	0
Resistant (?10%)	ICS-415	1
Moderately resistant (11-20%)	2025-1, ICS-411, 2066, ICS-418, ICS-420, 2256-1, 2412-1, SPT.NO-7, SPT.NO-59 and SPT.NO-131	10
Moderately susceptible (21-30%)	ICS-417, ICS-421, ICS-424, SPT.NO-11, SPT.NO-48, SPT.NO-164-2, 15R2NSP, 15G2SP, 13G3NSP and 14G2NSP	10
Susceptible (31-50%)	1931-1, ICS-406, 2049-1, ICS-413, ICS-416, ICS-422, 2402-1, SPT.NO-104, SPT.NO-108, SPT.NO-115, SPT.NO-124, SPT.NO-130, SPT.NO-155-1, SPT.NO-155-2, SPT.NO-157-1, SPT.NO-160, SPT.NO-161, K22-38, K22-37, K22-46 AND K22-49	21
Highly susceptible (>51%)	., SPT.NO-68, SPT.NO-94, SPT.NO-107, SPT.NO-113, SPT.NO-113/A and 13R2NSP	6

Castor lines reacted differently, which is ascribed to their unique genetic make-up and is suggestive of the resistance present in the parental lines examined. The screening of parental lines enables us to comprehend the severity of the lines response to the incidence of root rot. The breeders can create disease-free cultivars and hybrids by using those lines that displayed absolute resistance. These can then be tested in endemic areas and recommended for hybrid development and commercial production.

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