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REACTION OF FENUGREEK GENOTYPES AGAINST *Rhizoctonia solani,* CAUSING ROOT ROT DISEASE

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ABSTRACT

Root rot of fenugreek (*Trigonella foenum-graecum* L.), caused by *Rhizoctonia solani* has become an important constraint for fenugreek growers. The response of 109 fenugreek genotypes was observed under artificial inoculation conditions against root rot disease caused by *Rhizoctonia solani.* Five genotypes, viz., UM-209, UM-197, UM-230, UM-193 and RMt-259 were found highly resistant (HR). Thirty-one genotype resistant (R), fortyone genotype moderately resistant (MR) and twenty- three Susceptible (S) against root rot, respectively. Nine genotypes showed a highly susceptible (HS) reaction to the root rot disease of fenugreek. The study would be helpful for the development of a breeding program and further improvement of the fenugreek crop.
Keywords **:** Fenugreek, Root rot, *Rhizoctonia solani*, Screening, Susceptible, Resistant

Introduction

Fenugreek, *Trigonella foenum-graecum* L., is an herbaceous annual plant in the family Fabaceae grown for its leaves and seeds which are used as condiments as well flavoring agent food, pickles etc. The fenugreek plant may have a single stem or may be branched at the stem base. The plant has an erect growth habit and a strong, sweet aroma. It is used whole or powdered form and it is frequently roasted to lessen bitterness and enhance flavour. It has steroid 'diosgenin' which is used in preparation of contraceptives (drug serving to prevent pregnancy) as seen by Bakrim *et al.*, 2014. Fenugreek stimulates the digestive process as well as metabolism in general. In industry, seeds are used for the extraction of alkaloids and steroids. The green leaves are used to prepare vegetables, whereas dried leaves and flowers are used to flavor vegetable curries (Arya, 2000). Ancient herbal literature and religious scriptures both mention fenugreek as a therapeutic plant. It has been utilised in Indian Ayurvedic, Chinese, Greek and Arabian medicine as a traditional medicine (Sur *et al.*, 2001). Fenugreek is the largest grown spice in India with 6.42 per cent area share and 3.56 per cent production share to total spices production (Meena *et al.*, 2018). The fenugreek crop is suffers from many of fungal diseases viz., Cercospora leaf spot caused by *Cercospora traversiana*, root rot (*Rhizoctonia solani*), leaf spot (*Ascochyta* sp.), powdery mildew (*Erysiphe polygoni*), downy mildew (*Peronospora trigonellae*) and fusarium wilt (*Fusarium oxysporum*) (Prasad *et al.*, 2014). Among these, root rot of fenugreek caused by *Rhizoctonia solani*. Has become a very important constraint to the growers of fenugreek in the country. Young plants are more susceptible than older ones. At the seedling stage, the recorded rot incidence was 50–75% (Palanisamy *et al.*, 2010). Singh and Rao (2015) reported 34.67 per cent incidence of root rot of fenugreek caused by Rhizoctonia solani with yield loss of 55.26 per cent from Chhattisgarh. Under natural field conditions, the incidence of root rot disease was recorded as high as 56.19 per cent in Northern dry zone of Karnataka. (Rani and Hegde, 2017). However, not much work has been conducted on this disease in semi-aried region of Rajasthan, as most of the cultivars grown are susceptible to this disease. Hence, there is an urgent need to understand and undertake screening of the available genotypes for the identification of

resistant varieties. In the present study, an attempt was made to screen the available genotypes under artificial inoculation conditions.

Material and Methods

The present investigation was carried out for two consecutive years during Rabi season of 2023-24 and 2024-25 in the Instructional Farm, SKN College of Agriculture, SKN Agriculture University, Jobner situated in Semi-Arid Eastern Plain (Agro Climatic Zone III A) of Jaipur (Rajasthan) at 26° 5' N, latitude and 75°20' E longitude, at an altitude of 427 m above mean sea level. The soil in the region is sandy loam. Fenugreek germplasm comprising one hundred nine accessions collected from AICRP on Seed Spices, SKN College of Agriculture, Jobner formed the experimental material. The experiment was laid out in Randomised Block Design (RBD) with one hundred nine genotypes in three replications. 109 fenugreek genotypes were screened for root rot under artificial inoculation conditions. Inoculum multiplied on sterilized sorghum grains was added in furrows @ 20 g/m row length.

Observations were drawn on per cent disease incidence and were classified as follows (Mayee and Datar, 1986). The percent disease incidence was calculated using the following formula.

$$PDI = \frac{\text{Number of diseased plants}}{\text{Total number of plants observed}} \times 100$$

Later, PDI was grouped into the following grades to indicate the type of reaction followed by Patel *et al*., 2025.

Grades	Disease incidence (%)	Reaction
1	0-10	Highly resistant (HR)
2	11-20	Resistant (R)
3	21-30	Moderately resistant (MR)
4	31-50	Susceptible (S)
5	> 50	Highly susceptible (HS)

Based on their disease reaction, genotypes were categorized into highly resistant (HR), resistant (R), moderately resistant (MR), susceptible (S) and highly susceptible (HS) genotypes. Analysis of variance was carried out as per the procedure given by Panse and Sukthame (1967) using the mean values of random plants in each replication from all treatments to find out the significance of treatment effects.

Results and Discussion

All one hundred nine genotypes of fenugreek were screened in Rabi 2023-24 and 2024-25 against root rot disease under artificial inoculation conditions. Two years pooled data (Table 1, 2 and Fig. 1) revealed that the minimum disease incidence was recorded in the genotypes UM-209 (5.26%), UM-197 (5.83%), UM-230 (7.76%), UM-193 (9.86%) and RMt-259 (10.17%), whereas maximum disease incidence was observed in UM-241 (70.83%), Local methi (63.01%), UM-243 (62.97%), RMt-351(58.89%), Narendra Methi-2 (58.45%), AM-1(58.41%), UM-240 (57.82%), UM-384(54.34%) and RMt-305 (52.06%). Based on disease reaction, all the fenugreek genotypes were grouped into different categories, i.e. highly resistant (HR), resistant (R), moderately resistant (MR), susceptible (S) and highly susceptible (HS). Five genotypes namely UM-209, UM-197, UM-230, UM-193 and RMt-259 showed very low disease reaction as disease recorded was less than 11% hence these five genotypes are considered in category 1 as highly resistant (HR). Thirty one genotypes including RMt-143, RMt-303, RMt-354, AFG-1, AFG-3, AFG-4, AFG-5, PM-51, PM-62, FGK-139, FGK-145, FGK-147, FGK-154, FGK-155, UM-2, UM-11, UM-211, UM-214, UM-217, UM-224, UM-244, UM-249, UM-250, UM-254, UM-262, UM-274, UM-346,UM-376, UM-383, UM-385 and IC-64 showed disease reaction (between 11 to 20%) hence these genotypes are considered in category 2 as resistant (R),. Twenty three genotypes namely Narendra Methi-1, Narendra Richa, GM-1, Double Mango, Pant Ragenee, AM-2, APHU Methi-1, Hisar Manohar, HM-444, FGK-140, FGK-143, FGK-148, FGK-152, UM-68, UM-120, UM-124, UM-251, UM-263, UM-289, JEG-240, IC-4, IC-65 and IC-66 showed high disease reaction as disease recorded was (between 31 to 50%) hence these genotypes were considered in category 4 as susceptible (S). Reaction of resistance is a continuous process due to the evolution of new biotypes of the pathogen or the breakdown of resistance in host resistance. Combating plant disease through host resistance is an economic, ecologically safe and a viable proposition for disease management. Monoculture and lack of diversity predispose a crop to disease and the situation is more alarming in cases where pathogen evolution frequently takes place. One hundred nine genotypes were tested for their resistance to *R. solani*, causing root rot of fenugreek. In the present case, out of one hundred nine genotypes, tested for two consecutive cropping seasons, five genotypes, namely UM-209, UM-197, UM-230, UM-193 and RMt-259, were found highly resistant while nine genotypes, UM-241, Local methi, UM-243, RMt-351, Narendra Methi-2, AM-1, UM-240 ,UM-384 and RMt-305 were found highly susceptible to the pathogen.

In substantiating the present finding, Gupta *et al*., (1997) screened 110 lines of fenugreek for resistance to *Erysiphe polygoni*, *Rhizoctonia solani* and *Fusarium*

oxysporum in Hisar (Haryana). None of the genotypes were completely resistant to all three pathogens. However, GP 75, GP 82, GP 94, GP and PEB were the moderately resistant lines. Singh *et al*., (2010) evaluated three popular varieties of fenugreek against foot rot caused by *Fusarium moniliforme*, Deshi Methi was most susceptible to the disease showing maximum disease incidence (21-46%) followed by Pusa Early Bunching and Pusa Kasuri (17-43 and 8-23%). Rani *et al.* (2017) screened thirty-eight genotypes against Fusarium wilt of fenugreek under artificial inoculation conditions. Out of them, four genotypes like, DFC 3, DFC 8, DFC 27 and DFC 29 were found moderately resistant. Twenty eight genotypes were found moderately susceptible and three namely DFC 16, DFC 24 and DFC 25 showed susceptible reactions, while three genotypes were highly susceptible to the disease. Yadav *et al.*, (2019) reported that the reaction of RMT 354 and RMT 361 was observed to be moderately resistant against root rot. RMT 305 and Local were highly susceptible to the disease. Meena *et al.*, (2020) recorded two fenugreek varieties viz., Azad Methi (PDI 6.98) and AM 2 (PDI 8.54) were found highly resistant against root rot disease caused by Rhizoctonia solani under natural conditions. Desai *et al.*, (2022) observed the response of thirty two fenugreek genotypes tested against damping off disease, thirteen genotypes were found moderately resistant and moderately susceptible against damping off under natural conditions, respectively. Only one genotype showed susceptible reaction i.e., Sirsi Local. None of the genotypes were found highly susceptible, immune or resistant to the disease.

Conclusion

From the study, it can be concluded that, out of one hundred nine fenugreek genotypes tested against root rot disease, five genotypes were found highly resistant (HR), thirty one genotype resistant (R), forty one genotype moderately resistant (MR) and twenty three genotype susceptible (S) against root rot under artificial conditions, respectively. Nine genotypes showed a highly susceptible (HS) reaction to the root rot disease of fenugreek.

Table 1 : Screening of genotypes against rot root of fenugreek

S. No.	Genotypes	Percent Disease Incidence		Pooled PDI	Disease reaction
		2023-24	2024-25		
1.	RMt-1	21.03 (27.16)	24.30 (29.48)	22.67 (28.38)	MR
2.	RMt-143	18.67 (25.53)	16.84 (24.19)	17.76(24.89)	R
3.	RMt-259	8.75 (17.16)	11.59 (19.75)	10.17(18.53)	HR
4.	RMt-303	12.83 (20.96)	16.61 (24.02)	14.72 (22.54)	R
5	RMt-305	51.24 (45.69)	52.88 (46.64)	52.06 (46.17)	HS
6.	RMt-351	56.50 (48.74)	61.28 (51.53)	58.89 (50.12)	HS
7.	RMt-361	23.93(29.19)	24.38 (29.54)	24.16 (29.37)	MR
8.	RMt-354	19.66 (26.29)	14.72 (22.53)	17.19 (24.47)	R
9.	RMt-365	19.67 (26.31)	22.83 (28.49)	21.25 (27.43)	MR
10.	Narendra Methi-1	46.31 (42.85)	49.07 (44.45)	47.69 (43.65)	S
11.	Narendra Methi-2	59.76 (50.63)	57.13 (49.09)	58.45(49.86)	HS
12.	Narendra Richa	47.12 (43.33)	46.32 (42.86)	46.72 (43.10)	S
13.	GM-1	35.19 (36.36)	34.29 (35.82)	34.74 (36.09)	S
14.	Mango (PV)	22.15 (28.04)	26.69 (31.06)	24.42(29.58)	MR
15.	Double Mango	33.36 (35.26)	43.02 (40.97)	38.19 (38.15)	S
16.	Pant Ragenee	39.87 (39.13)	47.66 (43.64)	43.76 (41.40)	S
17.	AM-1	55.97 (48.43)	60.86 (51.27)	58.41 (49.83)	HS
18.	AM-2	33.75 (35.49)	34.58 (35.98)	34.17(35.74)	S
19.	APHU Methi-1	37.50 (37.72)	35.52(36.57)	36.51 (37.15)	S
20.	Rajandra Karanti	26.09 (30.65)	27.05 (31.31)	26.57 (31.00)	MR
21.	Lam Selection-1	26.85 (31.18)	28.61 (32.32)	27.73(31.76)	MR
22.	Hisar Manohar	46.79 (43.14)	48.02 (43.84)	47.41 (43.50)	S
23.	Hisar Sonali	28.55 (32.27)	24.18 (29.43)	26.36(30.88)	MR
24.	HM-444	31.84 (34.33)	37.54 (37.77)	34.69 (36.07)	S
25.	Pusa early bunching	26.70 (31.08)	18.45 (25.41)	22.58 (28.34)	MR
26.	AFG-1	13.08 (21.18)	11.21 (19.53)	12.15 (20.37)	R
27.	AFG-3	18.97 (25.80)	20.33 (26.77)	19.65 (26.29)	R
28.	AFG-4	18.11(25.16)	16.94 (24.25)	17.52 (24.71)	R
29.	AFG-5	12.97 (21.04)	15.42 (23.11)	14.20 (22.11)	R

30.	PM-18	29.09 (32.63)	27.31 (31.49)	28.20 (32.06)	MR
31.	PM-19	26.01 (30.65)	20.86 (27.15)	23.44 (28.94)	MR
32.	PM-51	18.45 (25.41)	19.68 (26.30)	19.06 (25.86)	R
33.	PM-53	23.74 (29.14)	22.26(28.14)	23.00 (28.64)	MR
34.	PM-62	15.08 (22.82)	13.37 (21.43)	14.23 (22.14)	R
35.	FGK-139	18.45 (25.41)	16.41 (23.87)	17.43 (24.65)	R
36.	FGK-140	36.77 (37.31)	33.37 (35.27)	35.07 (36.30)	S
37.	FGK-141	29.09 (32.63)	23.64 (29.07)	26.36 (30.88)	MR
38.	FGK-142	25.43 (30.26)	24.21 (29.45)	24.82 (29.86)	MR
39.	FGK-143	34.71 (36.08)	45.58 (42.44)	40.14 (39.29)	S
40.	FGK-144	29.56 (32.92)	28.04 (31.96)	28.80 (32.44)	MR
41.	FGK-145	15.31 (23.01)	17.90 (25.01)	16.60 (24.03)	R
42.	FGK-146	19.15 (25.93)	25.97 (30.62)	22.56 (28.35)	MR
43.	FGK-147	15.63 (23.25)	14.33 (22.23)	14.98 (22.75)	R
44.	FGK-148	34.71(36.08)	36.23 (36.98)	35.47 (36.53)	S
45.	FGK-149	25.63 (30.39)	25.98 (30.60)	25.81 (30.50)	MR
46.	FGK-150	22.94 (28.59)	21.02 (27.27)	21.98 (27.94)	MR
47.	FGK-151	25.85 (30.55)	31.95 (34.40)	28.90 (32.51)	MR
48.	FGK-152	33.26 (35.20)	39.12(38.70)	36.19 (36.97)	S
49.	FGK-153	24.06 (29.36)	29.67 (32.99)	26.87(31.21)	MR
50.	FGK-154	16.06 (23.59)	20.50 (26.91)	18.28 (25.30)	R
51.	FGK-155	12.43 (20.61)	14.33 (22.23)	13.38 (21.44)	R
52.	UM-2	17.32 (24.56)	19.27 (26.03)	18.29 (25.31)	R
53.	UM-11	11.47 (19.76)	14.30 (22.20)	12.88(21.02)	R
54.	UM-68	31.93 (34.38)	37.54 (37.76)	34.73(36.10)	S
55.	UM-114	18.97(25.80)	25.01(29.99)	21.99 (27.95)	MR
56.	UM-120	34.71(36.08)	30.47 (33.49)	32.59 (34.79)	S
57.	UM-122	26.01 (30.65)	24.18 (29.44)	25.10 (30.05)	MR
58.	UM-123	27.20 (31.42)	21.78 (27.81)	24.49 (29.64)	MR
59.	UM-124	32.28(34.60)	36.04 (36.88)	34.16 (35.75)	S
60.	UM-141	21.14 (27.35)	27.63 (31.69)	24.38 (29.57)	MR
61.	UM-149	25.20 (30.10)	24.02(29.33)	24.61 (29.72)	MR
62.	UM-150	25.21 (30.12)	27.31 (31.49)	26.26 (30.81)	MR
63.	UM-151	28.72 (32.39)	21.53 (27.63)	25.13 (30.07)	MR
64.	UM-161	29.04 (32.59)	26.20 (30.77)	27.62 (31.69)	MR
65.	UM-193	9.36 (17.81)	10.35 (18.75)	9.86 (18.28)	HR
66.	UM-197	4.34 (11.98)	7.31(15.65)	5.83 (13.96)	HR
67.	UM-209	3.45 (10.63)	7.07 (15.39)	5.26(13.22)	HR
68.	UM-211	15.64 (23.27)	19.74 (26.36)	17.69 (24.85)	R
69.	UM-214	20.84 (27.14)	19.03 (25.80)	19.93 (26.50)	R
70.	UM-217	11.85 (20.12)	16.81 (24.17)	14.33 (22.22)	R
71.	UM-219	23.00 (28.64)	29.17 (32.65)	26.08 (30.69)	MR
72.	UM-224	9.01 (17.43)	15.42 (23.11)	12.22 (20.44)	R
73.	UM-230	5.57 (13.58)	9.95 (18.34)	7.76 (16.16)	HR
74.	UM-233	21.67 (27.72)	27.29 (31.47)	24.48 (29.63)	MR
75.	UM-240	59.93 (50.71)	55.72 (48.27)	57.82 (49.48)	HS
76.	UM-241	74.86 (59.89)	66.79 (54.79)	70.83 (57.29)	HS
77.	UM-243	61.41 (51.59)	64.53 (53.46)	62.97 (52.52)	HS
78.	UM-244	13.72 (21.71)	21.90 (27.88)	17.81 (24.94)	R
79.	UM-246	24.06 (29.36)	25.20 (30.11)	24.63 (29.74)	MR
80.	UM-249	10.85 (19.20)	16.04 (23.59)	13.45 (21.50)	R
81.	UM-250	11.93 (20.17)	20.12 (26.61)	16.03 (23.57)	R
82.	UM-251	47.34 (43.46)	45.49(42.39)	46.41 (42.92)	S
83.	UM-253	25.69 (30.43)	27.65 (31.70)	26.67 (31.08)	MR
84.	UM-254	17.17 (24.46)	16.06 (23.59)	16.61 (24.03)	R
85.	UM-262	10.45 (18.80)	14.88 (22.67)	12.67 (20.81)	R
86.	UM-263	43.91 (41.49)	46.45 (42.95)	45.18 (42.22)	S

87.	UM-264	21.67(27.72)	24.20 (29.45)	22.94 (28.60)	MR
88.	UM-274	10.09 (18.47)	14.28 (22.18)	12.18 (20.41)	R
89.	UM-289	34.56 (35.99)	35.71 (36.67)	35.14 (36.34)	S
90.	UM-298	26.85 (31.19)	28.61 (32.32)	27.73 (31.76)	MR
91.	UM-302	21.99 (27.95)	25.11 (30.06)	23.55 (29.02)	MR
92.	UM-304	28.05 (31.97)	25.59 (30.36)	26.82 (31.18)	MR
93.	UM-344	24.13 (29.39)	30.44 (33.46)	27.28 (31.47)	MR
94.	UM-346	19.90 (26.46)	13.88 (21.84)	16.89 (24.24)	R
95.	UM-376	10.65 (18.99)	16.06 (23.60)	13.36 (21.40)	R
96.	UM-377	22.23 (28.10)	24.13 (29.40)	23.18 (28.75)	MR
97.	UM-379	26.87 (31.20)	19.47 (26.11)	23.17 (28.73)	MR
98.	UM-383	18.68 (25.58)	16.30 (23.75)	17.49 (24.71)	R
99.	UM-384	53.69 (47.10)	55.00 (47.86)	54.34 (47.48)	HS
100.	UM-385	17.18 (24.44)	16.55 (23.97)	16.87 (24.22)	R
101.	JEG-240	42.64 (40.75)	35.17 (36.36)	38.90 (38.57)	S
102	JEG-250	25.85 (30.55)	24.84 (29.85)	25.35 (30.21)	MR
103.	IC-4	31.62 (34.20)	32.91 (34.98)	32.26 (34.59)	S
104.	IC-5	23.39 (28.90)	25.48 (30.28)	24.44 (29.60)	MR
105.	IC-64	17.17 (24.46)	14.50 (22.37)	15.83 (23.44)	R
106.	IC-65	46.65 (43.06)	48.72 (44.25)	47.69 (43.65)	S
107.	IC-66	36.90(37.37)	35.11 (36.31)	36.01(36.86)	S
108.	IC-69	27.95 (31.88)	25.70 (30.43)	26.82 (31.18)	MR
109.	Local Methi	60.55 (51.09)	65.46 (54.00)	63.01 (52.54)	HS
S.Em.±		**0.91**	**0.89**	**0.72**	
CD (P=0.05)		**2.53**	**2.47**	**1.20**	
C.V. %		**5.15**	**4.89**	**4.00**	

*Average of three replications
Figures in parentheses are angular transformed values

Table 2 : Reaction of Fenugreek Genotypes/Germplasm to Root Rot Disease Under Field Conditions

Rating Scale	Disease reaction	Disease incidence (%)	No. of entries	Entries
1	Highly resistant (HR)	0-10	5	RMt-259, UM-193, UM-197, UM-209, UM-230
2	Resistant(R)	11-20	31	RMt-143, RMt-303, RMt-354, AFG-1, AFG-3, AFG-4, AFG-5, PM-51, PM-62, FGK-139, FGK-145, FGK-147, FGK-154, FGK-155, UM-2, UM-11, UM-211, UM-214, UM-217, UM-224, UM-244, UM-249, UM-250, UM-254, UM-262, UM-274, UM-346,UM-376, UM-383, UM-385, IC-64
3	Moderately resistant (MR)	21-30	41	RMt-1, RMt-361, RMt-365, Mango (PV), Rajandra Karanti, Lam Selection-1, Hisar Sonali, Pusa early bunching, PM-18, PM-19, PM-53, FGK-141, FGK-142, FGK-144, FGK-146, FGK-149, FGK-150, FGK-151, FGK-153, UM-114, UM-122, UM-123, UM-141, UM-149, UM-150, UM-151, UM-161, UM-219, UM-233, UM-246, UM-253, UM-264, UM-298, UM-302, UM-304, UM-344, UM-377, UM-379, JEG-250, IC-5, IC-69
4	Susceptible (S)	31-50	23	Narendra Methi-1, Narendra Richa, GM-1, Double Mango, Pant Ragenee, AM-2, APHU Methi-1, Hisar Manohar, HM-444, FGK-140, FGK-143, FGK-148, FGK-152, UM-68, UM-120, UM-124, UM-251, UM-263, UM-289, JEG-240, IC-4, IC-65, IC-66
5	Highly susceptible (HS)	>50	9	RMt-305, RMt-351, Narendra Methi-2, AM-1, UM-240, UM-241, UM-243, UM-384, Local methi

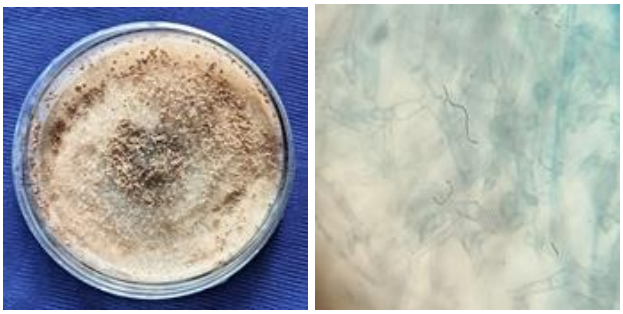

Fig. 1 : Cultural and morphological characteristic of *Rhizoctonia solani*

Fig. 2 : Symptoms on fenugreek plants

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