The Pharma Innovation Journal 2022; SP-11(6): 255-258

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(6): 255-258

www.thepharmajournal.com
Received: 01-04-2022
Accepted: 06-05-2022

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Response of fenugreek genotypes against *Rhizoctonia solani*, causing damping off

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Abstract
Damping off or root rot of fenugreek, caused by *Rhizoctonia solani* has become an important constraint to the growers of fenugreek. An investigation was carried out for two consecutive years during *Rabi* season of 2019-20 and 2020-21 in the Department of Plantation, Spices, Medicinal and Aromatic Crops, Kittur Rani Channamma College of Horticulture, Arabhavi, to screen available thirtytwo fenugreek genotypes against damping off under natural field condition. During two consecutive years (2019-20 & 2020-21) and in pooled data, 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.

Keywords: Fenugreek, damping off, *Rhizoctonia solani*, susceptible, immune

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 a herb or spice. 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. Traditional medicine has recognised fenugreek as a powerful plant. Its seeds are rich in protein with a favourable amino acid profile, lipids and biogenic components (Srinivasan, 2006) [11]. 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) [12]. 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) [3].
But fenugreek suffers from many of fungal diseases *viz.*, Cercospora leaf spot caused by *Cercospora traversiana*, damping off/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) [7]. The present study is concerned with one of the major diseases of fenugreek called damping off/root rot caused by the fungi like *Rhizoctonia solani.* Although many diseases are reported in fenugreek, this is becoming more severe in recent years. Young plants are more susceptible than older ones. At seedling stage the recorded rot incidence was 50–75% (Palanisamy *et al.*, 2010) [5]. Under natural field conditions, the incidence of this disease was recorded up to 56.19 per cent in Northern dry zone of Karnataka. (Rani and Hegde, 2017) [8, 9]. However not much work has been conducted on this disease in Karnataka, 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 the resistant varieties. In the present study, an attempt was made to screen the available genotypes under natural field condition.

Material and Methods
The present investigation was carried out for two consecutive years during *Rabi* season of 2019-20 and 2020-21 in the Department of Plantation, Spices, Medicinal and Aromatic Crops, Kittur Rani Channamma College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot situated in Northern dry zone (Zone No. 3; Region-2) of Karnataka at 16°15' N latitude and 74°45' E longitude, at an altitude of 612 m above mean sea level.

The experiment was laid out in Randomised Block Design with thirty two genotypes in three replications. Fenugreek germplasm comprising of thirty-two accessions collected from different regions formed the experimental material.

Field screening of fenugreek genotypes for damping off

Thirtytwo fenugreek genotypes were screened against damping off under field condition. Observations were drawn on per cent disease incidence and was classified as follows (Mayee and Datar, 1986) [2]. The per cent disease incidence was calculated by using the following formula.

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

Later, PDI was grouped into following grades to indicate the type of reaction

Infection	Reaction
No symptoms in plants	Immune
1% or less mortality	Resistant
1-10% Mortality	Moderately resistant
11-25% Mortality	Moderately susceptible
26-50% Mortality	Susceptible
51% or more mortality	Highly susceptible

Based on their disease reaction, genotypes were categorized into immune, resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible genotypes.

Analysis of variance was carried out as per the procedure given by Panse and Sukthame (1967) [6] using the mean values of random plants in each replication from all treatments to find out the significance of treatment effects.

Results and Discussion

To identify the sources of resistance, thirty-two genotypes were screened against damping off under natural epiphytic conditions during *rabi* season of 2019-20 and 2020-21. The data on reaction of each variety during two consecutive years (2019-20 & 2020-21) and in pooled data is presented in Table 1.

During two consecutive years (2019-20 & 2020-21) and in pooled data, thirteen genotypes viz., DFC 8 (8.57%, 6.98% & 7.78%), DFC 14 (10.48%, 10.48% & 10.48%), DFC 17 (8.57%, 9.21% & 8.89%), DFC 18 (10.48%, 9.84% & 10.16%), DFC 20 (9.21%, 8.57% & 8.89%), DFC 24 (10.48%, 10.79% & 10.63%), DFC 27 (7.30%, 5.71% & 6.51%), Ajmeer Methi 3 (6.67%, 6.35% & 6.51%), Ajmeer Methi 4 (8.89%, 9.84% & 9.37%), Lam M 2 (7.30%, 8.57% & 7.94%), Pusa Early Bunching (5.40%, 5.08% & 5.24%), CO 1 (9.21%, 10.16% & 9.68%) and Kushtagi Local (8.57%, 9.84% & 9.21%) were found moderately resistant under natural conditions. Thirteen genotypes viz., DFC 4 (12.38%, 14.92% & 13.65%), DFC 5 (17.78%, 23.17% & 20.48%), DFC 6 (11.75%, 11.11% & 11.43%), DFC 9 (14.29%, 13.97% & 14.13%), DFC 10 (13.02%, 14.29% & 13.65%), DFC 16 (12.06%, 12.70% & 12.38%), DFC 19 (12.70%, 13.97% & 13.33%), DFC 21 (11.11%, 12.06% & 11.59%), DFC 25 (12.06%, 12.70% & 12.38%), DFC 28 (10.79%, 12.38% & 11.59%), DFC 29 (13.02%, 15.56% & 14.29%), Ajmeer Methi 2 (11.11%, 11.43% & 11.27%) and Gujarat Methi 2 (11.11%, 11.11% & 11.11%) were found moderately susceptible under natural conditions. The genotype DFC 15 showed moderately susceptible reaction during 2019-20 (11.11%), but moderately resistant reaction during 2020-21 and pooled data (10.48% & 10.79%, respectively). The genotype Ajmeer Methi 1 showed moderately resistant reaction during 2019-20 and in pooled data (9.84% & 10.48%, respectively) but moderately susceptible reaction during 2020-21 (11.11%). The genotype CO 2 showed moderately resistant reaction during 2019-20 (9.21%), whereas moderately susceptible reaction during 2020-21 and in pooled data (11.75% & 11.11%, respectively). The genotype Arabhavi Local showed moderately resistant reaction during 2019-20 and in pooled data (8.89% & 10.16%, respectively), whereas moderately susceptible reaction during 2020-21 (11.43%). The genotype Belagavi Local showed moderately susceptible reaction during 2019-20 and in pooled data (22.54% & 24.44%, respectively), whereas susceptible reaction during 2020-21 (26.35%). Only one genotype showed susceptible reaction i.e., Sirsi Local (27.30%, 31.11% & 29.21%). None of the genotypes were found highly susceptible, immune or resistant to the disease.

Similar studies were also carried out by Gupta *et al*. (1997) [1], where 110 lines of fenugreek were screened for resistance to *Erysiphe polygoni*, *Rhizoctonia solani* and *Fusarium oxysporum* in Hisar (Haryana). None of the genotypes was 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) [10] 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) [8, 9] screened thirtyeight genotypes against *Fusarium* wilt of fenugreek under artificial inoculation condition. 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 reaction and three genotypes were highly susceptible to the disease. Yadav *et al*. (2019) [13] reported that the reaction of RMT 354 and RMT-361 were observed to be moderately resistant against root rot. RMT 305 and Local were highly susceptible to the disease. Meena *et al*. (2020) [4] 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.

Table 1: Screening of fenugreek genotypes against damping off under field condition

Sl. No.	Treatments	2019-20		2020-21		Pooled	
		PDI (%)	Reaction	PDI (%)	Reaction	PDI (%)	Reaction
1	DFC 4	12.38	MS	14.92	MS	13.65	MS
2	DFC 5	17.78	MS	23.17	MS	20.48	MS
3	DFC 6	11.75	MS	11.11	MS	11.43	MS
4	DFC 8	8.57	MR	6.98	MR	7.78	MR
5	DFC 9	14.29	MS	13.97	MS	14.13	MS
6	DFC 10	13.02	MS	14.29	MS	13.65	MS
7	DFC 14	10.48	MR	10.48	MR	10.48	MR
8	DFC 15	11.11	MS	10.48	MR	10.79	MR
9	DFC 16	12.06	MS	15.24	MS	13.65	MS
10	DFC 17	8.57	MR	9.21	MR	8.89	MR
11	DFC 18	10.48	MR	9.84	MR	10.16	MR
12	DFC 19	12.70	MS	13.97	MS	13.33	MS
13	DFC 20	9.21	MR	8.57	MR	8.89	MR
14	DFC 21	11.11	MS	12.06	MS	11.59	MS
15	DFC 24	10.48	MR	10.79	MR	10.63	MR
16	DFC 25	12.06	MS	12.70	MS	12.38	MS
17	DFC 27	7.30	MR	5.71	MR	6.51	MR
18	DFC 28	10.79	MS	12.38	MS	11.59	MS
19	DFC 29	13.02	MS	15.56	MS	14.29	MS
20	Ajmeer Methi 1	9.84	MR	11.11	MS	10.48	MR
21	Ajmeer Methi 2	11.11	MS	11.43	MS	11.27	MS
22	Ajmeer Methi 3	6.67	MR	6.35	MR	6.51	MR
23	Ajmeer Methi 4	8.89	MR	9.84	MR	9.37	MR
24	Lam M 2	7.30	MR	8.57	MR	7.94	MR
25	Pusa Early Bunching	5.40	MR	5.08	MR	5.24	MR
26	Gujarat Methi 2	11.11	MS	11.11	MS	11.11	MS
27	CO 1	9.21	MR	10.16	MR	9.68	MR
28	CO 2	10.48	MR	11.75	MS	11.11	MS
29	Arabhavi Local	8.89	MR	11.43	MS	10.16	MR
30	Kushtagi Local	8.57	MR	9.84	MR	9.21	MR
31	Belagavi Local	22.54	MS	26.35	S	24.44	MS
32	Sirsi Local	27.30	S	31.11	S	29.21	S
	Mean	11.39		12.36		11.88	
	S.Em±	2.12		2.14		1.60	
	CD (0.05)	5.99		6.06		4.52	

I-Immune R-Resistant MR-Moderately Resistant MS-Moderately Susceptible S-Susceptible HS- Highly Susceptible

Conclusion

From the study it can concluded that, out of thirtytwo 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.

Acknowledgment

Authors extend thanks to Dept. of PMA, KRC College of Horticulture, Arabhavi, UHS, Bagalkot for providing necessary facilities required for the study.

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