

## Variation Among Promising Genotypes of Fenugreek (*Trigonella foenum graecum* Linn.) for Symbiotic Nitrogen Fixation

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**Abstract :** A study was conducted on eleven high yielding varieties of fenugreek, along with a local variety, to evaluate their symbiotic potential with five local *Rhizobium meliloti* isolates under controlled conditions. Significant differences were observed among the host genotypes and rhizobial isolates in respect of six symbiotic traits studied on plants cultured for 33 days. Interaction between the host and rhizobia was also significant for all the traits. On the basis of plant nitrogen content, isolate FR 3 and FR 9 were found superior. Host genotype UM 117 was generally a superior symbiotic partner.

**Key words :** Fenugreek, symbiotic efficiency, N fixation, rhizobia.

Fenugreek, an important seed spice crop of Rajasthan, is a leguminous crop nodulated by fast growing native *Rhizobium meliloti* strains. Though in nature the crop benefits from symbiotic N<sub>2</sub> fixation, no systematic approach has yet been made to assess and improve its symbiotic potential. It has consistently been realized that in grain legumes selection of appropriate strain of *Rhizobium*, and that of the host genotypes, may be effective in increasing the symbiotic N<sub>2</sub> fixing potential (Caldwell and Vest, 1977; Dixon and Wheeler, 1986 and Buttery *et al.*, 1992). The present study was, therefore, taken up to evaluate the symbiotic efficiency of 12 promising high yielding varieties of fenugreek which have been developed under All India Coordinated Spices Improvement Project, Jobner Center, in symbioses with 5 rhizobial isolates under controlled conditions.

### Materials and Methods

Five *Rhizobium meliloti* isolates namely, FR 1, FR 3, FR 5, FR 6 and FR 9, used in the present investigation, were laboratory

isolates made from clonal culture of nodules recovered from different local fenugreek plantations, as described by Vincent (1970) and tested for their nodulating ability on fenugreek plant variety RMt-1, under controlled conditions. The bacterial isolates were maintained on Yeast Mannitol (YM) agar slants and transferred into YM broth tubes and cultured for regrowth at  $26 \pm 2^\circ\text{C}$  in an incubator. 5 ml of late exponential phase culture was used for inoculations.

For aseptic culture of plants, surface sterilized seeds of 12 different fenugreek varieties in 3 replications were sown 1 cm deep in sterile pure sand contained in a glass vessel (400 ml). After 2 days of emergence the seedlings were inoculated. Three seedlings of each genotype, receiving the rhizobial inoculations, were cultured under fluorescent light (5000 lux) and irrigated with Thorton's (1949) N-free mineral solution, as and when required. The uninoculated plants served as control. After 33 days of growth, the experiment was terminated and plants were harvested for recording observations on the symbiotic traits.

Symbiotic effectiveness of individual treatments was based on total N-content, determined following Snell and Snell (1939). The data were analyzed as per factorial C.R.D. (Panse and Sukhatme, 1967)

### Results and Discussion

Nodules produced on the host genotypes due to rhizobial inoculations were pinkish in appearance and spherical to oblong in shape (1-2 mm in size), indicative of development of normal and effective symbiosis under the conditions of the experiment. The differences among both the rhizobial and the host genotypes were statistically significant ( $p < 0.01$ ) in respect of the six traits studied, and hence, both the rhizobial cultures and host genotypes were adequately diverse to accomplish the objectives of the present study.

All the five rhizobial cultures were effective in symbiosis with the host plants. The hierarchy of performance of five rhizobial isolates was not same when compared on the basis of two or more symbiotic traits (Table 1). However, on the basis of total nitrogen content per plant, the performance of isolates FR 3 and FR 9 was best and comparable with each other. Existence of strain differences have been demonstrated in rhizobia of legumes such as fenugreek (Provorov and Simarov,

1990), bottle bean (Alvarez-soils and Leon-Martinez, 1991) and french bean (Hungaria and Neves, 1987) and moth bean (Rao and Venkateswarlu, 1983).

The evaluation of performance of ten promising genotypes of fenugreek evaluated, in comparison to RMT-1 (a released high yielding variety) and a local one revealed, that the symbiotic efficiency of genotype UM 117 excelled all others on the basis of plant nitrogen content. For other traits like nodule fresh weight, nodule dry weight, and plant dry weight, UM 117 recorded highest/higher values (Table 2). The performance of local variety was the poorest of all, as judged by nitrogen content. Existence of host strain differences have been reported in pigeon pea (Namdeo *et al.*, 1991), soybean (Ballati and Pueppke, 1990), pea (Antipchuk *et al.*, 1984) and chick pea (Gaur and Sen, 1986).

Further, the interaction between the rhizobial isolates and host genotypes was significant for all the characters studied. Table 3 highlights the highest values, falling within the limits of C.D. recorded for symbiotic performance in respect of each trait. It may be seen that UM 117 in symbiosis with FR 9 was represented for all the traits except plant

Table 1. Response of different *Rhizobium meliloti* isolates in symbiosis with 12 different genotypes of fenugreek under controlled conditions

Rhizobial inocul's	Characters*					
	Nodules/plant	Nodule fresh weight (g)	Nodule dry weight (g)	Plant fresh weight (g)	Plant dry weight (g)	Total N-content
FR 1	16.82	7.68	1.41	378.98	51.34	0.882
FR 3	14.50	12.88	1.64	439.98	57.34	1.225
FR 5	19.42	10.84	1.62	441.50	55.99	1.005
FR 6	14.92	7.40	0.97	368.42	52.48	0.998
FR 9	17.59	14.49	2.65	491.01	58.22	1.276
Control	-	-	-	329.90	42.75	0.598
C.D. (5%)	2.32	2.31	0.33	40.50	3.58	0.100

\* Values represent means of observations recorded on twelve different genotypes of the host.

Table 2. Different symbiotic traits observed on 12 genotypes of fenugreek in symbiosis with various rhizobial inoculations under controlled conditions

Host genotype	Nodule/plant	Nodule fresh weight (g)	Nodule dry weight (g)	Plant fresh weight (g)	Plant dry weight (g)	Total nitrogen
UM 32	19.60	12.08	2.06	420.95	57.73	1.1427
UM 34	19.93	14.16	1.95	391.06	54.09	0.9839
UM 116	12.73	5.96	0.80	319.62	46.65	0.8935
UM 117	21.33	16.34	2.90	462.80	62.88	1.4366
UM 118	18.40	10.21	1.71	404.41	55.90	0.9707
UM 127	18.00	8.48	0.96	390.41	54.61	0.9866
UM 128	15.40	9.45	1.85	438.60	52.09	1.0334
UM 129	12.67	5.56	0.83	409.23	55.46	1.0882
UM 143	15.53	9.04	1.54	463.52	57.00	1.0089
UM 144	15.13	10.86	1.48	409.41	45.38	0.8147
Local	10.27	8.04	1.43	378.96	46.88	0.6782
RMt-1	20.60	17.71	2.22	410.86	50.22	0.9444
C.D. (5%)	3.53	3.59	0.52	28.64	5.07	0.14

Value represent the average of five individual inoculation treatments in respect of a host genotypes.

fresh weight. Since the rhizobial isolates exhibited compatibility with more than one host genotype in respect of all the traits studied, a clear cut rhizobial specificity of a host genotype was not marked in the material in-

vestigated, although, preference for a particular strain has been demonstrated in legumes by Namdeo *et al.* (1991), Ballati and Pueppke (1990), Gaur and Sen (1986) and Antipchuk *et al.* (1984). Based on the results

Table 3. Best rhizobium combination with host genotypes in respect to six symbiotic characters studied

Strain/Traits	FR 1	FR 3	FR 5	FR 6	FR 9	C.D. (5%)
Number of Nodules	Um 127 (28.00)	UM 117 22.34	RMt-1 (29.69)	UM 143 (30.34)	UM 117 (26.00)	7.91
Nodule fresh weight	UM 16.87	UM 117 (22.64)	RMt-1 (20.34)	UM 34 (19.77)	UM 117 (26.46)	8.03
Nodule dry weight	LOCAL 3.03	UM 32 2.80	UM 34 2.90	RMt-1 1.97	UM 117 (6.34)	1.17
Plant fresh weight	UM 34 482.24	UM 143 (614.80)	UM 117 566.67	RMt-1 421.74	UM 128 (696.30)	99.22
Plant dry weight	UM 118 (69.90)	UM 129 (74.10)	UM 117 (68.87)	UM 117 (68.60)	UM 117 (71.34)	12.43
Total nitrogen cont. plant	UM 117 1.5048	UM 127 (1.9533)	UM 117 (1.8616)	UM 34 1.6609	UM 117 (1.7120)	0.35

The values in parenthesis represent that the characters are stastically at par. The values are mean for the treatment combinations.

of this study, the existence of useful potential among the symbiotic partners may be exploited under field conditions through the rhizobial inoculation on efficient host variety.

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