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An induced determinate mutant in fenugreek (*Trigonella foenum-graecum* L.)

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Abstract

A determinate mutant was isolated from a population of 400 plants of fenugreek (*Trigonella foenum-graecum* L.) in the M2 generation raised from 200 seeds of Rmt 1 (indeterminate variety) treated with ethyl methane sulphonate (EMS) 0.10% for 4 h. Random samples from all M2 populations (except the mutant) were advanced to M3 generation. The appearance of one determinate type in a sample of 798 plants indicated that the trait is monogenic. This mutant was grown along with Rmt 1 and UM 305 (spontaneous mutant for similar growth habit). There were significant differences among genotypes for plant height, number of pods per plant, seed yield per plant and aphid infestation. The study indicated that the performance of the mutant could be brought on par with the checks following selection for desired economic traits.

Key words: fenugreek, induced mutant, *Trigonella foenum-graecum.*

Basic genetic information of fenugreek (*Trigonella foenum-graecum* L.), an important seed spice, is scanty. This is primarily due to the lack of easily identifiable variants for most Mendelian traits. Empirical evidences and available literature suggest that genetic variability for most of the economic characters is also limited (Edison 1997). Artificial mutagenesis is one of the tools which may either create *de novo* plant type or enhance existing variability for most morphological as well as economic traits. The present investigation deals with some properties of an induced mutant type with growth-arresting inflorescence following mutagenic treatments in a commercial variety of fenugreek with indeterminate growth habit.

Rmt 1, a pure line variety of fenugreek with indeterminate growth habit, was used for mutagenic treatment. Three samples of 200 seeds each were soaked in distilled water for 24 h. Among the three samples, one was kept as control. The remaining two samples were treated with ethyl methane sulphonate (EMS) 0.10% and 0.25%, respectively, for 4 h, then washed and dried. The treated and untreated (control) seeds were sown separately in the field during 1997-98. The experiments were conducted at S K N College of Agriculture, Jobner, Rajasthan. At maturity, seeds were collected from each treatment separately and 400 seeds taken at random from each treatment were sown separately in the subsequent year.

A single determinate mutant was observed in the M2 population, advanced from EMS 0.10% treated seeds. This M2 population (except the mutant) and the control were again harvested separately. In the following year, randomly taken two samples (1596 seeds each) of the treatment were advanced to M3 generation to look into recurrence of determinate types. During the same planting season (1999-2000), the isolated determinate M2 mutant was grown along with the parental material and UM 305 (spontaneous determinate mutant identified during 1996) in alternate rows (2 rows of 80 plants for each treatment). The data on plant height, aphid infestation, pods per plant and seed yield per plant were recorded on five competitive plants in each row. The analysis of variance was performed by partitioning the total variation into, between genotypes and within genotypes. (Sukhatme & Amble 1989).

All the treated and untreated (control) seeds germinated during the first year of the experiment. However, there was a reduction in vigour of the treated seeds compared to the control and this appeared to be directly proportional to the concentration of EMS. But all the plants produced pods and set seeds. During this generation, no variants for growth habit were observed; all plants showed indeterminate growth habit.

In the second year of the experiment, one determinate plant was observed in the M2 population, which descended from EMS (0.10%) treated material. This indicated that the determinate growth habit is a recessive trait. By extrapolation, indeterminate growth habit appears to be a completely dominant trait since no intermediate types were observed during M1 generation. The occurrence of the determinate type following artificial mutagenesis in the intermediate variety was not unexpected because the phenotype of mutant deviates in a direction which is opposite to the previous selection history of the parental material (Brock 1957). No determinate plant was found in the second M2 population (descended form EMS 0.25% treated material). It could be because the effect of any mutagen is random and therefore, appearance of a mutation in one treated material does not guarantee in any way the appearance of the same in other sample treated with either the same or a different dose of the same mutagen.

It is obvious that the mutant must have been derived from fusion of two mutant gametes. It was hypothesized that if the trait was monogenic, two indeterminate plants might be present in the heterozygous condition in the M2 population of 400 plants. Thus a total of 4 gametes out of 800 could be mutants, which implied a mutation frequency of 0.5×10^{-2}. Further, doubling the sample size (excluding the mutant) could lead to the appearance of one determinate type, on an average, in the M3 generation had the trait been monogenic. This hypothesis was tested by growing two M3 populations, each of 1596 plants (assuming 100 % survival) in two separate plots (Table 1). Two determinate types were observed (an average of one determinate type for each 798 plants) in each plot which confirmed that the

Table 1. Frequency of determinate mutations induced in fenugreek

Year	Treatment	Population size	Determinate mutations
1997-98	Seeds of RMt1 treated with EMS 0.25%	200	0
	Seeds of RMt1 treated with EMS 0.10%	200	0
	Control	200	0
1998-99	M2 Population of M1 bulk (EMS 0.25%)	400	0
	M2 Population of M1 bulk (EMS 0.10%)	400	1
	Control	400	0
1999-2000	M3 Population from M2 bulk (EMS 0.10%)	a. 1596	2
	(except the mutant)	b. 1596	2
	Control	1596	0

Table 2. Analysis of variance in mutant progeny and checks

Treatment	df	Mean squares			
		Plant height (cm)	Aphid infestation**	No. of pods $plant^{-1}$	Seed yield $plant^{-1}$ (g)
Between genotypes	2	487.03*	15.43*	486.09*	11.26*
Within genotypes	27	16.4	3.35	126.31	3.35

* Significant at P = 0.05

** Aphid infestation was quantified on 0 – 9 scale

Table 3. Mean and range of values for various characters in mutant progeny and checks

Character	Mutant progeny		UM305		Rmt10		LSD 5%
	Mean	Range	Mean	Range	Mean	Range	
Plant height (cm)	26.20	14 – 30	28.30	23 – 34	39.20	34 – 44	3.70
Aphid infestation (0-9 scale)	4.00	0 – 8	1.80	0 – 4	1.90	0 – 4	1.68
No. of pods $plant^{-1}$	18.80	7 - 41	32.50	26 – 50	23.40	27 – 52	10.30
Seed yield $plant^{-1}$ (g)	5.56	3.1 – 9.0	7.49	5.1 – 9.6	7.29	6.0 – 10.0	1.68

trait is monogenic. The monogenic recessive nature of determinate growth habit was also noticed in beans (Allard 1960) and tomato (Rick 1978).

The M3 progeny of the isolated M2 mutant bred true to the type which indicated that the mutant was homozygous. The analysis of variance of the mutant progeny along with the checks indicated the presence of significant variation among genotypes for all the traits (Table 2). The range of values for various characters of mutant progeny was conspicuous compared to the checks implying that the mutant was still segregating for traits other than the growth habit and it could be possible to improve it through selection since its upper limits for number of pods and seed yield were comparable to those of checks (Table 3). The study also indicated that a similar scope existed for improvement of fenugreek against aphid infestation.

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