

MUTAGENIC EFFICIENCY OF EMS AND γ -RAYS IN FENUGREEK (*TRIGONELLA FOENUM GRAECUM* L.)

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ABSTRACT

Seeds of fenugreek variety UM-75 were treated with three doses each of EMS and γ -rays. In M_1 generation 40, 60 and 80 kR of γ -rays induced more cytomorphological damage than 0.4, 0.6 and 0.8% EMS. Normal appearing plants selected from each treatment were advanced to M_2 generation. In M_2 , lowest concentration of EMS (0.4%) generated maximum genetic variability for most of the traits. The estimates of heritability and genetic gain were also of higher order in this treatment.

INTRODUCTION

Fenugreek is used as condiment, spice, vegetable and also as fodder. The seeds are rich in protein and have medicinal value also. Traditional methods of plant breeding have not yielded desired results in improving the genetic potential of this crop mainly because of limited amount of genetic variability available. Mutation breeding, has been successfully used for generating genetic variability in pigeonpea (Rao et al. 1985), mungbean (Khan 1985), soybean (Upadhyaya et al. 1987) and lentil (Sarkar and Sharma 1989). Very little work on this aspect has been done in fenugreek. Therefore, an attempt was made to investigate the mutagenic effects of EMS and γ rays particularly in terms of induction of micromutations in fenugreek.

MATERIAL AND METHODS

Seeds of variety UM-75 were treated with freshly prepared solutions of EMS 0.4, 0.6 and 0.8%. The treatment duration was six hours. Before treatment, the seeds were soaked in distilled water for four hours. Three doses of γ -rays viz., 40 kR, 60 kR and 80 kR were used. On termination of treatment, the seeds were thoroughly washed in running tap water. M_1 generation was raised in both flats and field using randomized block design with three replications. For M_2 generation 20 normal appearing M_1 plants were selected from each treatment. The M_2 generation was raised in compact family block design with three replications. Four meter long single row of each progeny was taken. Row to row and plant to plant distances were maintained as 40 cm and 15 cm, respectively. Estimates of variability viz., GCV, PCV, heritability

Table 1. Mean values under different treatments for different quantitative characters in M₁ generation of fenugreek

Treatment	Germi- nation (%)	Survival (%)	Seedling height (cm)	Days to 50% flowering	Days to maturity	Pollen fertility (%)	Plant height (cm)	Number of primary branches	Number of pods/ plant	Pod length (cm)	Number of grains/ pod	Test weight (g)	Yield per plant (g)
Control	99.0	100.0	8.9	70.0	116.0	98.6	56.7	6.4	71.7	10.8	16.5	2.2	8.0
EMS 0.4	87.0	96.2	8.8	70.6	117.0	88.3	55.3	5.7	59.3	9.3	13.5	2.7	4.6
EMS 0.6	84.0	93.9	8.8	71.3	118.3	55.0	58.4	6.1	54.3	8.9	9.3	3.2	3.1
EMS 0.8	76.8	91.0	8.7	74.3	118.0	51.6	58.8	5.9	46.2	8.6	9.7	2.6	2.5
40 kR	88.0	95.0	8.5	77.0	116.0	71.6	57.5	6.6	44.8	9.5	11.4	3.2	3.5
60 kR	86.2	92.0	8.3	76.3	115.0	63.3	54.1	6.7	53.1	9.2	10.4	3.2	2.7
80 kR	80.0	90.0	8.2	80.6	111.3	48.3	35.7	5.8	24.9	7.8	10.3	2.7	0.9
CD 5%	4.6	4.9	0.1	1.5	3.1	3.1	6.0	0.7	5.3	0.9	2.5	0.7	1.3

Table 2. Frequency of chromosomal aberrations during mitosis under different treatments in M₁ generation of fenugreek

Treatments	No. of cells analysed at Metaphase	Anaphase	Total cells analysed	Legg- ards	Breaks	Dots	Brid- ges	Clups	Uneq- ual separ- ation	Per- cent- age
Control	25	25	50	—	—	—	—	—	—	—
EMS 0.4	27	23	50	2	—	1	1	—	—	8
EMS 0.6	26	24	50	2	2	1	1	—	—	12
EMS 0.8	25	25	50	1	2	—	2	—	1	12
40 kR	24	26	50	1	2	2	3	1	—	18
60 kR	24	27	50	2	—	2	3	1	2	20
80 kR	23	27	50	2	—	3	3	2	—	20

and genetic gain were computed in all those families which exhibited significant progeny differences. Progenies significantly superior over the best progeny control were isolated using 't' test.

RESULTS AND DISCUSSION

In M_1 , both EMS and γ -rays reduced mean of most of the characters except plant height and number of branches. Test weight was significantly increased at intermediate doses of γ -rays. Higher concentration of EMS delayed the maturity but higher doses of γ -rays enhanced the same (Table 1). Gamma irradiation caused more cytological damage than EMS (Table 2). Gamma rays treatment induced high frequency of dicentric bridges at all the three concentrations, whereas EMS treatment caused more chromosomal breaks and laggards.

Normal appearing plants having fertility were carried forward to M_2 generation. Maximum variability in all the components of grain yield was generated by 0.4% EMS. The heritability of these variables was high and the expected genetic gain was also more (Table 3). This treatment generated significant variability in grain yield but

Table 3. Variability parameters in M_2 generation of fenugreek

Treatment	Coefficient of genotypic variation	Coefficient of phenotypic variation	Heritability (%)	Genetic gain
Pod length (cm)				
EMS 0.4	9.54	11.54	68.31	18.11
40 kR	5.91	8.48	48.58	8.51
Number of grains per pod				
EMS 0.4	14.80	19.07	60.25	23.67
EMS 0.6	15.05	23.40	41.39	20.00
40 kR	6.68	10.44	41.01	8.77
60 kR	10.33	16.49	39.20	13.82
Test weight (g)				
EMS 0.4	16.34	18.33	79.52	30.21
EMS 0.6	10.54	17.08	38.05	13.13
60 kR	7.23	9.29	61.89	11.32
Yield per plant (g)				
EMS 0.4	17.26	25.23	46.78	24.40

the estimates of heritability and genetic gain were moderate, therefore confirming that lower concentration of mutagen are more effective for induction of micromutations. Lower and intermediate dose of γ -rays also generated significant variability for pod length, number of grains per pod and test weight but its magnitude was less than that of EMS. Superior progenies over the best progeny of control were observed in 0.4% EMS treatment for number of grains per pod. Such progenies were also present in 40 kR

dose of gamma rays. The magnitude of increase by EMS treatment was higher (33.5%) than that of γ rays (29.2%). Thus on over all basis EMS generated maximum genetic variability for most of the traits.

REFERENCES

- Khan, I.A. 1985. Studies on induced genetic variability in quantitative characters on mung bean (*Vigna radiata*). *Thailand Journal of Agricultural Sciences* 18 : 247-258.
- Rao, D., Manohar and Thummala P. Reddy. 1985. Differential radio and chemosensitivities of pigeon pea (*Cajanus cajan*) varieties. *Genetica Agrararia* 39: 153-162.
- Sarkar, A. and Sharma, B. 1989. Induction and screening of polygenic variability for multiple characters in lentil (*Lens culinaris* Medik). *Indian Journal of Genetics and Plant Breeding* 47 : 179-182.
- Upadhyaya, H.D., Singh, B.B. and Chauhan, K.P.S. 1987. Induced polygenic variability in soyabean. *Journal of Nuclear and Agricultural Biology* 16 : 120-126.