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Efficiency and effectiveness of physical and chemical mutagens in *Trigonella foenum graecum* L.

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Abstract
Trigonella foenum graecum L was utilized to study the Chlorophyll mutations, mutagenic efficiency and effectiveness by physical mutagen gamma rays and chemical mutagen EMS. The frequency of chlorophyll mutation in M_1 & M_2 generation were more in gamma treated plants but the mutation spectra and mutagenic efficiency of EMS was higher than gamma. The most efficient mutagens were 0. 02% EMS, 0. 06% EMS and 3KR gamma radiation to induce mutation in *T. foenum graecum* L.

Keywords: Mutagens, Mutation, Mutation efficiency, mutagenic effectiveness

Mutation breeding has been widely used for crop improvement by developing new plant types with superior genotypes and better adaptive potentiality. Induced mutation have contributed a lot for creating additional variability and to the development of new cultivars (Broertjes and Harten, 1978). Different types of physical and chemical mutagens have been successfully employed to introduce mutation and more than eight hundred commercial cultivars have been released (Novak and Micke, 1987).

Trigonella foenum graecum L. is a small seeded, self pollinated annual herb which is having very high nutritional and medicinal values. The plant is also having insect and pest repellent property (Billaud and Adrian, 2001). Being a self pollinated crop the plant is having less genetic variability and it can be increased by adopting mutation breeding programme. Since the frequency of mutation depends on efficiency and effectiveness of mutagens, therefore an attempt has been made to estimate the efficiency & effectiveness of physical mutagen gamma rays and chemical mutagen EMS on *T. foenum graecum* L.

Materials and Methods

Seeds of *T. foenum graecum* L cv. PEB were subjected to gamma irradiation and EMS treatment. For gamma irradiation 1000seeds of uniform size and moisture content 11. 5% were arranged in monolayer and subjected to acute dose of 1KR, 2KR, 3KR, 4KR &5KR at. BBCI, Guwahati, Assam. The source of gamma is Cobalt ^{60} and average energy is 1. 25 Mev. For chemical mutagen the seeds were presoaked in distilled water for 12 hours then treated with freshly prepared aqueous solution of EMS (0. 02%, 0. 04 %, 0. 06%, 0. 08% &0. 1%) for 8hrs. Then the seeds were washed thoroughly with water to avoid residual effect of mutagen. Immediately after treatment seeds were sown in randomized block design (30 ×7. 5cm spacing) with three replications to raise M_1. M_1 plants were harvested individually and grown to raise M_2 as progeny rows. The biological effects of different treatments evaluated in 200 plants each of M_1 & M_2 generations. Seed germination, seedling survival percentage and percentage of chlorophyll mutation were scored on M_1 plant progeny and M_2 population basis. The mutagenic

Table 1: Frequency of chlorophyll mutants (on M_1 plant progeny & M_2 population basis), mutagenic efficiency and mutagenic effectiveness in treated and control population of *T. foenum graecum* L.

Treatments & dose	Total no. of M_1/M_2 plants scored	M_1 mutant frequency%	M_2 mutant frequency%	Mutagenic efficiency	Mutagenic effectiveness
Control	200/200	-	-	-	-
Gamma rays					
1KR	200/200	11.2	1.75	0.37	1.33
2KR	200/200	19.6	2.11	0.4	1.27
3KR	200/200	20.8	5.5	0.44	0.9
4KR	200/200	20.3	2.97	0.37	0.65
5KR	200/200	19.4	1.77	0.36	0.5
EMS					
0.02%	200/200	3.6	1.52	0.46	22.5
0.04%	200/200	8.4	1.99	0.58	26.3
0.06%	200/200	9.5	4.92	0.62	21.7
0.08%	200/200	11.6	1.98	0.55	18.1
0.10%	200/200	12.9	1.4	0.56	16.1

Table 2: Frequency & spectrum of chlorophyll mutations (M_1 plants progeny basis) in *T. foenum graecum* L.

Treatment & dose	Chlorophyll mutations			Total %
	Albino	Chlorina	Straita	
Gamma ray				
1KR	5.2	4.3	1.7	11.2
2KR	7.1	7.8	4.7	19.6
3KR	18.6	2.2	-	20.8
4KR	16.8	3.8	-	20.3
5KR	19.4	-	-	19.4
EMS				
0.02%	2.0	1.2	0.4	3.6
0.04%	3.1	5.3	-	8.4
0.06%	2.4	4.7	2.4	9.5
0.08%	6.2	3.5	1.9	11.6
0.1%	-	8.9	4.0	12.9
Control	-	-	-	-

efficiency and effectiveness were worked out following Konzak *et. al.* , 1965.

Results and Discussion

M_1 Generation

Seed germination and seedling survival percentage was progressively decreased with increase dose of gamma rays & EMS. Maximum reduction was observed at 5KR gamma and 0. 1% EMS. Sterility percentage was also positively correlated with mutagen doses and it may be due to degeneration of egg nucleus and abortion of embryo sac in mutagen treated plants. Frequencies of chlorophyll mutations were almost identical in different doses of gamma radiation except 1KR which showed lowest value 11. 2%. However, considerable increase of mutation frequencies were observed with increase dose of EMS and maximum was recorded in 0. 1 % (Table1). Dose dependent mutation were also reported earlier in several crops (Mitra and Bhowmik 1997; Venkateswarlu *et. al.*, 1988)

M_2 Generation

Gamma rays produced more viable mutants than EMS. Treatment with 3KR gamma showed highest mutation frequency and lowest was recorded in 0. 02% EMS. Relative frequency of chlorophyll mutation varied with dose of mutagen used. Although gamma rays created higher mutation frequency but gave narrow spectrum (Table 2) this result supported the findings of Kumar and Mani (1997). The present studies revealed that efficiency of EMS was markedly higher than the gamma rays in spite of gamma treatment recording high frequency of mutation than EMS. Higher mutagenic efficiency of EMS than gamma rays was reported earlier in rice (Kaul & Bhan, 1977). However, efficiency and effectiveness of a mutagen is also depends on genetic background and intracellular condition of the specimen treated. From the present investigation it can be concluded that most efficient mutagen doses are 0. 06% EMS, 0. 02%EMS and 3KR gamma ray for production of mutant in *T. foenum graecum* L.

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