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Research Notes

Mutagenic effectiveness and efficiency of gamma rays and ems in soybean (*Glycine max* (l.) Merrill)

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Soybean (*Glycine max* (L.) Merrill) tops the world production of oil seeds. Mutation breeding is the most useful and vital technology for soybean improvement. Selection of effective and efficient mutagen is very essential to recover high frequency of desirable mutants. The seeds of vegetable soybean varieties Himso 1563 and TS 82 were used for this study. Gamma rays and EMS were selected for the mutation study.

Each sample comprising 160 dry and well-filled uniform size seeds were treated with gamma rays (10,20,30,40 and 50kR) and EMS (5,10,15,20 and 25mM). Gamma ray treatment was made in Center for Plant Breeding and Genetics, TNAU, Coimbatore. The treated seeds along with control were sown immediately in the field to raise M_1 generation. Different biological parameters like germination, survival and fertility were recorded in M_1 generation. In M_2 generation, the M_1 generation seeds as well as control progenies were screened for lethal chlorophyll mutations during first 5 weeks after germination, where as viable chlorophyll and morphological mutations were scored throughout the crop duration. Mutation frequency was calculcated as percentage of mutated M_2 progenies for both chlorophyll and morphological mutations in each treatment. The mutagenic effectiveness and efficiency were computed using the formula suggested by Konzak *et al.* (1965)

Mutagenic effectiveness

$$\frac{M \times 100}{krad} \quad \text{or} \quad \frac{M \times 100}{t \times c}$$

Mutagenic efficiency

$$\frac{M \times 100}{L} \qquad \frac{M \times 100}{S} \qquad \frac{M \times 100}{I}$$

Where,

M = Chlorophyll or viable or non-viable mutation frequency on M_2 plant basis.

krad = Dose of irradiation

c = Concentration of chemical mutagen (mM)

t = Soaking hours

L = Percentage of lethality, i.e., percentage of reduction in survival of seedlings on 30^{th} day.

I = Percentage of injury, i.e., percentage of reduction in height of plants on 30^{th} day (cm).

S = Percentage of seed sterility i.e., percentage reduction in seed fertility.

In M_1 generation, three important biological parameters were recorded as percentage over control (Table 1)

Pollen fertility percentage decreased along with increased dose/ concentration of mutagens. The lowest level of pollen fertility was observed

Table 1. Effect of mutagens on Germination, Plant Survival and Seed Fertility in M_1 generation of soybean.

Mutagen	Treatment	Germination %*		Survival %*		Seed fertility%*	
		Himso1563	TS 82	Himso1563	TS 82	Himso1563	TS 82
Gamma	Control	94.20	95.65	70.11	72.35	70.58	71.89
rays(kR)	10	86.00	89.00	65.33	68.88	66.84	67.42
	20	76.00	77.00	60.33	58.11	65.04	64.81
	30	53.00	48.00	45.00	43.85	63.83	58.38
	40	39.00	35.00	38.00	35.66	62.89	50.80
	50	17.50	17.50	22.38	22.67	61.44	43.60
EMS(mM)							
	5	82.50	88.00	65.87	66.63	68.06	66.59
	10	76.00	75.50	59.34	60.67	63.08	61.53
	15	49.00	49.00	43.86	43.28	61.09	57.40
	20	36.50	39.00	36.87	35.68	50.09	49.98
	25	15.50	14.00	21.97	22.78	43.98	43.65

** arc sine transformed values.*

at 50kR in TS 82 (33.86 percent). For seed fertility also inverse relationship was seen with dose/ concentrations. The lowest level of seed fertility was observed at 25mM in Himso 1563 (43.60 percent).

In the present study, effectiveness of mutagenic doses differed considerably (Table.1) for Himso 1563. Highest level of effectiveness was observed at 50kR treatment for both Himso 1563 (15.45 percent) and TS 82 (14.27 percent). Compared to gamma rays, EMS was less effective. This work was also done by Gautam (1998) in black gram.

The effectiveness of chlorophyll mutants ranged from 5.05 to 6.66 per cent in Himso 1563 and from 6.00 to 10.78 per cent in TS 82 for gamma rays treated population. For EMS the effectiveness of chlorophyll mutants ranged from 2.76 to 3.32 per cent in Himso 1563 and from 3.11 to 4.36 per cent in TS 82. Gamma rays were more effective for the production of chlorophyll mutants (Table.2).

Effectiveness and efficiency are two different properties of mutagen. A highly effective mutagen may not necessarily show high efficiency and *vice versa* (Jayakumar and Selvaraj, 2003) in sunflower. Both the physical (50kR) and chemical (15mM) mutagens were found to be most efficient (Table.2). In most of the treatments efficiency increased with increase in dose/concentration. Compared to gamma rays, in EMS lower concentrations were more efficient. But medium, higher doses of gamma rays were more efficient than medium and higher concentrations of EMS. In both mutagens characters like sterility, lethality and injury were increased with increased doses/concentrations. This work was also done by Gupta and Sharma

Table 2. Mutagenic effectiveness and efficiency based on chlorophyll mutations of Gamma and EMS treated M_2 generation

Treatment Dose/cncentration	Survival reduction (%) Lethality	Seed fertility reduction(%) Sterility	Height reduction (%) injury	Mutants (M) per 100 M_2 seedlings	Effectiveness MX 100 tXc (or) krad	Efficiency MX 100 L	MX 100 S	MX 100 I
Himso 1563 (Gamma rays kR)								
10	15.50	10.65	7.30	0.54	5.40	3.48	5.07	7.40
20	25.10	12.98	10.35	1.01	5.05	4.04	7.78	9.76
30	43.21	15.94	11.20	1.78	8.90	4.13	11.16	15.89
40	65.51	24.83	18.68	2.55	6.38	3.92	10.26	13.65
50	82.50	30.00	22.65	3.33	6.66	4.06	11.10	14.70
TS 82 Gamma rays (kR)								
10	16.50	12.34	8.65	0.75	7.50	4.54	6.08	8.67
20	23.52	12.99	10.91	1.20	6.00	5.21	9.24	10.10
30	48.12	23.04	11.82	2.39	7.96	5.00	10.37	20.22
40	60.23	25.24	19.43	3.18	7.95	5.30	12.60	16.37
50	78.15	27.54	22.04	4.25	10.78	5.40	15.43	19.28
Himso 1563 EMS (mM)								
5	14.75	9.85	9.50	0.98	3.26	6.60	9.95	10.32
10	24.12	15.77	11.06	1.99	3.31	8.29	12.62	17.99
15	50.30	22.56	14.17	2.88	3.32	6.64	12.76	20.32
20	62.24	28.08	17.82	3.32	2.76	5.35	11.82	18.63
25	84.81	40.66	24.05	4.51	2.39	5.37	11.09	18.75
TS 82 EMS (mM)								
5	11.25	10.68	6.64	1.31	4.36	11.64	12.27	19.73
10	26.12	15.80	9.44	2.23	3.71	8.58	14.11	23.62
15	22.30	26.38	13.48	3.52	3.37	13.81	13.35	26.11
20	64.52	29.72	18.57	3.73	3.11	5.85	12.55	20.09
25	81.32	40.11	24.88	5.61	3.74	6.93	13.99	22.55

(1990) in rice; Mehere and Mahajan (1996) in soybean. From this study it could be concluded that EMS is more effective for the production of chlorophyll mutants and gamma rays for viable mutants.

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Research Notes

Induced mutants for quality characters in vegetable soybean *(Glycine max* (L.) Merrill)

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Soybean *(Glycine max* (L.) Merrill) a member of the family Fabaceae produces tiny flowers. Therefore mutation breeding is more desirable to create variability in soybean (Bhatnagar *et al.,* 1979). In the present investigation, mutations were induced in two soybean cultivars Himso 1563 and TS 82 by treating the seeds with different doses of Gamma rays and different concentrations of EMS.The plants of the M_2 generations were screened for qualitative mutations. The present investigation was carried out to isolate the desirable quality mutants in M_2 generation of Himso 1563 and TS 82 cultivars of soybean. The seeds were subjected to 10, 20, 30, 40 and 50 kR gamma rays and 5, 10, 15, 20 and 25mM concentrations of EMS. About 160 seeds were used for each treatment after presoaking in water (6hrs); again seeds were soaked in EMS for 6 hrs. Then the treated seeds were rinsed with running tap water for half an hour with gentle shaking. Untreated seeds of both cultivars were soaked in distilled water for the same period to serve as controls. After this, 60 seeds per treatment with two replications were immediately sown in the research field by following randomized block design to raise the M_1