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INDUCTION OF MUTATION IN MUNGBEAN

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Ethyl methane sulphonate (EMS), an alkylating mutagen was used to induce mutation in mungbean (*Vigna radiata* Linn). A considerable biological damage was caused by EMS in the treated population (M_1) The percentage of germination, emergence and survival was adversely affected in the higher concentrations of the mutagen. Abnormalities in cotyledonary leaves and mature leaves (lobed, unifoliate, bifoliate, tetrafoliate and pentafoliate) were recorded in M_1 . Five chlorophyll (albina, virescens, alboviridis, albescens and maculata) and three morphological (unifoliata, erectoid and dwarf) mutants were screened in M_2 segregation.

Keywords : Induced mutation; EMS; *Vigna radiata;* Biological damage; Segregation; Frequency.

Introduction

Mungbean (*Vigna radiata*), a well known pulse crop with high protein value, has been shown to be a good genetic material for induced mutation studies, employing both physical and chemical mutagens (Santos, 1969; Chaturvedi and Singh, 1978; Bandyopadhyay, 1979; Khan and Hashim, 1979). Thus, in the present communication an attempt has been made to study the effect of ethyl methane sulphonate (EMS) on mungbean in M_1 and M_1 generations.

Material and Methods

Seed samples of Pusa Baisakhi variety were obtained from Jobner campus, Agriculture University, Udaipur (Rajasthan) to raise the plants. Seeds from a single plant formed the stock seeds for the chemical treatment. Dry seeds (100-150) were treated with various concentrations (0.025–0 100 M) of EMS for 20 h, thoroughly washed with tap water and were shown in petriplates as well as in pots. A control was also maintained using distilled water instead of chemical mutagen. Each treated population (M_1) was screened during vegetative, flowering and fruiting periods. One hundred seeds from each M_1 plant were sown to raise M_2 population. The mutants were isolated from M_2 segregation.

Results and Discussion

Ethyl methane sulphonate induced a lot of biological damage to the mungbean. Various parameters were used to find the extent of biological damage caused by EMS to mungbean (Table 1). A gradual decrease in germination, emergence and survival percentage was recorded with corresponding increase in the concentration of the mutagen. Formation of abnormal cotyledonary leaves such as three cotyledonary leaves instead of two and reduced cotyledonary leaves were resulted due to (0.050 M) mutagenic treatments (Fig. 1 A–B). Morphological variations in leaf such as unifoliate (0.075 and 0.400 M), bifoliate (0.050 and 0.075 M), trifoliate with reduced rachilla (0.075 M), pinnate leaf with four leaflets (0.025 M), tetrafoliate (0.025 M) and pentafoliate (0.050 M) were recorded (Fig. 1C). These morphological variations in leaf appeared due to chemical action. In the treated plants reduced fertility and small sized pods with less number of seeds were commonly observed (Table 1).

Both chlorophyll and morphological mutants were obtained in M_2 generation. Chlorophyll mutants were classified according to Gustafsson (1969). Five types of chlorophyll mutants viz. albina, virescens, alboviridis, albescens and maculata were isolated (Table 3). Frequency of various categories of induced chlorophyll mutations was found to be in the order, virescens>maculata>albina>albescens>alboviridis. No dose relationship was observed between frequencies of chlorophyll mutation induced and various doses employed (Table 2). Chlorophyll mutants have been described in brief as follows :

Virescens : Mutants were characterised by uniform light green coloured leaves. Mutation viable.

Albina : Seedlings possessed small cotyledonary leaves devoid of chlorophyll or carotenoid. Seedlings died within 5 8 days after germination. Mutation lethal.

Maculata : Initially normal leaves but later on small dots of yellow colour appeared on the lamina. At maturity these dots were well distributed all over the surface of the leaves. Bred true in M_3.

Albescens : Patches of white colour appeared on the leaves of mature plants with the leaves turning completely white or yellow-white later on. Mutation viable. Bred true in M_3 generation.

Alboviridis : Young leaves possessed yellow colour at the tip in the beginning, turning to white within 3–4 days with the lamina base remaining green. Mutation viable.

Table 1. Biological damage in Mungbean caused by EMS treatment at different levels

Concentration used (molar)	Germination (%)	Emergence (%)	Survival (%)	Plant height (cms) Mean ± S.E. (3 weeks old)	Number of pods per plant Mean ± S.E.	Length of the pod (cms) Mean ± S.E.	Number of seeds per pod Mean ± S.E.
Control	100	98	95	13.67 ± 0.67	40 ± 1.68	7.8 ± 0.12	12 ± 0 34
0.025	93	83	80	11.70 ± 0.53	34 ± 1.23	6.6 ± 0.05	11 ± 0.15
0.050	80	75	70	8.90 ± 0 72	30 ± 1.07	6.4 ± 0.03	9 ± 0.08
0.075	60	66	62	6.40 ± 0.26	23 ± 2 41	5.9 ± 0.11	8 ± 0.05
0.100	40	33	31	5.50 ± 0.24	17 ± 1.50	5.2 ± 0 75	6 ± 0.23

100–150 seeds per treatment and control.

Table 2. Frequency of various chlorophyll and morphological mutations in Mungbean caused by EMS treatment.

EMS Conc. (molar)	Population size		Percentage mutation frequency	
	M_1 Plants	M_2 Seedlings	M_1 Plants	M_2 Seedlings
Control	60	825	—	—
0.025	48	393	10	0.75
0.050	52	437	20	1.38
0.075	52	427	30	1.38
0.100	55	457	20	1.32

True breeding behaviour in M_3 generation.

Three morphological mutants viz., erectoid, dwarf and unifoliate were screened. Characteristic features of these mutants when compared to the control (Fig. 2 A) were described as below :

Erectoid : Erect habit and elongation of hypocotyl region was the characteristic features of mutant (Fig. 2 B). Mutation viable. Bred true in M_3 generation.

Dwarf : Stunted growth and less number of branches gave the mutant a dwarf appearance. Early flowering and fruiting as compared to parental type were other reproductive features observed in this mutant (Fig. 2 C). Mutation viable. True breeding behaviour in M_3.

Unifoliata : Cotyledonary leaves were small and crumpled. Adult leaves with one terminal leaflet were striking features of the mutant (Fig. 2 D). Mutant survived upto fourth leaf stage. Mutation lethal.

Genetics of the various mutants were studied from the heterozygous plants in M_3 generation (Table 4). All these types segregated into simple 1:3 ratio indicating monogenic recessive nature of the mutants.

Detrimental effects of EMS to the mungbean has been reported earlier by Santos (1969), Chaturvedi Singh (1978) and Krishnaswami and Rathinam (1980). But the nature and extent of biological damage caused by EMS has been shown to be different in various reports, which might be due to the different cultivars of the mungbean used in

Table 3. Frequency of various types of chlorophyll and morphological mutations in Mungbean (in M_2) caused by EMS treatment (in percentage).

EMS Concentration (molar)	Albina	Virescens	Alboviridis	Albescens	Maculata	Unifoliata	Erectoid	Dwarf
Control	—	—	—	—	—	—	—	—
0.025	2.25	0.50	—	—	—	—	—	—
0.050	—	0.23	—	—	0.46	—	0.23	0.46
0.075	0.23	0.26	0.23	0.23	0.23	—	—	—
0.100	—	0.22	—	0.22	0.44	0.44	—	—

Table 4. Segregation of different chlorophyll and morphological mutants in heterozygous line in M_3 generation.

Chlorophyll and morphological mutants	Frequency of		Total	$x^2 = (3:1)$	p
	Normal	Mutant			
Albina	23	6	29	0.415	0.70 – 0.50
Virescens	22	7	29	1.689	0.20—0.10
Alboviridis	18	5	23	1.086	0 30—0.25
Albescens	24	7	31	0.168	0.70—0.50
Maculata	28	8	36	0.148	0.70—0.50
Unifoliata	10	4	14	0.051	0 90—0.80
Erectoid	29	9	38	0.133	0.75 - 0 70
Dwarf	23	7	30	0.049	0 90—0.80

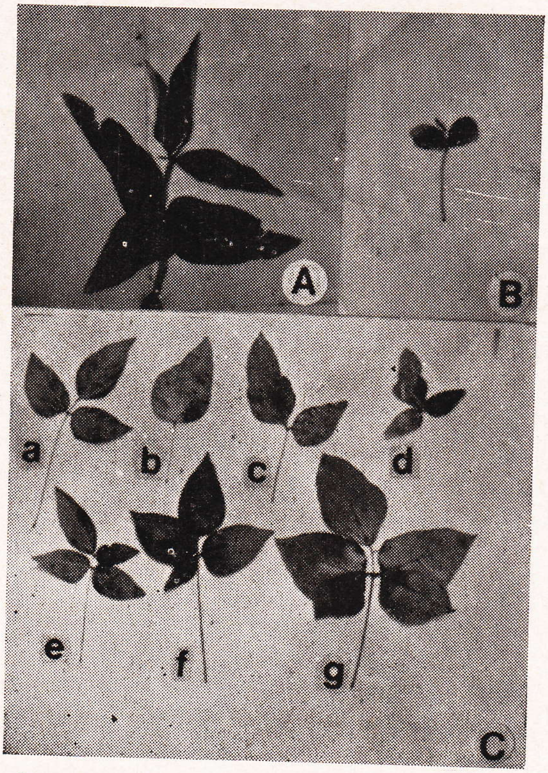

Fig. 1. Abnormal cotyledonary and mature leaves in M_1
A—Three cotyledonary leaves; B – Reduced cotyledonary leaves; C—(a) Trifoliate leaf from control; (b) Unifoliate leaf; (c) Bifoliate leaf; (d) Trifoliate leaf with reduced rachilla; (e) Pinnate leaf with four leaflets; (f) Tetrafoliate leaf; (g) Pentafoliate leaf.

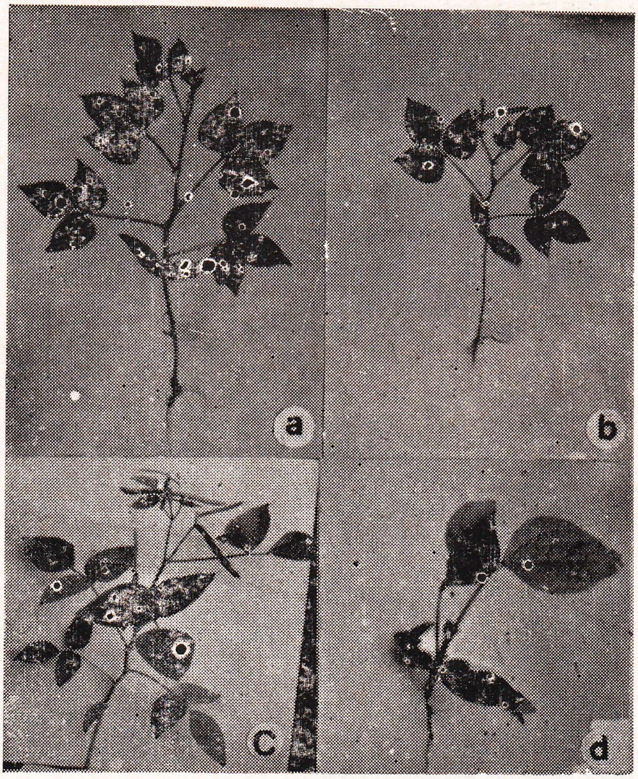

Fig. 2. Morphological mutants of *Vigna radiata* Linn.
a – Control; b – Erectoid; c – Dwarf; D – Unifoliata.

different experiments. Reduction in germination, emergence percentage and formation of aberrant plants in treated series may be attributed to the disturbances caused at the physiological level of the cell/or chromosomal damage, as earlier pointed out by Sinha and Godward (1972). Formation of abnormal seedling indicates the direct effect of EMS on the meristems, as previously expressed by Dass and Mukherjee (1968) and reduction in seedling growth has been explained by Rao and Rao (1983) as an arrest of mitotic cycle at shoot apex level.

In the present study both morphological and chlorophyll mutants were isolated in M_2 population. Earlier Santosh (1969) and Krishnaswami and Rathinam (1980) also succeeded in inducing various types of morphological and chlorophyll mutants in mungbean employing EMS and Gamma rays. On the contrary Bandyopadhyay and Bose (1979) isolated morphological mutants after the treatment with EMS and Gamma rays. Out of the three morphological mutants isolated presently, dwarf mutant exhibiting few improved agricultural characteristics such as early flowering and fruiting could be of applied value.

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