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FREQUENCY AND SPECTRUM OF MUTATIONS INDUCED BY PHYSICAL AND CHEMICAL MUTAGENS IN *MOMORDICA CHARANTIA* L.

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Several viable mutants exhibiting change in their morphology such as plant stature, maturity, vegetative characters, fruit and seed characters of phylogenetic interest and practical value were isolated from *Momordica charantia* after treatment with various doses of physical and chemical mutagens viz., gamma rays, Mitomycin-C and EMS.

Key words: Gamma rays MC EMS Mutants Triomonoecious

In changing the present practice in agriculture a revolutionized method of plant improvement is inevitable. The use of induced mutations has become a common practice of almost all plant breeders. Mutational studies and mutation breeding techniques are essentially the prerequisites for inducing new variability in plants. In the present paper the frequency and spectrum of viable mutations induced by physical and chemical mutagens in *M. charantia* are discussed.

MATERIALS AND METHODS

Healthy seeds of *M. charantia* (Co-long variety) were exposed to 30, 40, 50 and 60 kR doses of gamma rays. Aqueous EMS solution was prepared with concentration of 0.1% and 0.2% treated for 6 hours after 24 hours presoaking in distilled water. 0.01% and 0.02% concentration of MC was given for 1/2 hour only. A number of viable mutants were screened from M_2 generation. The frequency and spectrum of mutations and their quantitative characters are given in tables 1 & 2.

RESULTS AND DISCUSSION

A wide spectrum of viable mutations were observed in the M_2 generation affecting morphological traits. The chemical mutagen (EMS) produced a relatively higher frequency of viable mutations than the physical mutagens (gamma rays) and Mitomycin-C (Table1). From the mutants isolated, except one, completely sterile mutant, all were viable. Data collected on six quantitative characters in M_3 generation (Table 2) showed that the viable mutants were superior than their normal parents. In the course of investigation the following mutants were isolated from the M_2 population.

Table 1: Comparison of spectrum and frequency of sterile and viable mutations in M_2 generation of *Momordica charantia* after Gamma rays, MC and EMS treatments.

Mutants	Mutation frequency %		
	Gamma rays	EMS	MC
Leathery leaf	1.23	2.18	-
Drooping leaf	1.08	-	-
Abnormal leaf	-	3.082	-
Dwarf	-	-	2.43
Sterile	-	-	3.26
Semi-sterile	1.42	3.04	2.08
Early flowering	4.38	6.32	2.32
Trimonoecious	2.32	-	-
Bifid stigma	-	3.08	-
Olive green fruit	-	4.38	-
Long fruit	3.22	6.30	4.32
Stout fruit	-	-	2.30
Round & small fruit	2.39	-	-
Irregular fruit	2.42	3.00	3.22
Fasciated	-	3.92	–
Mutated seed coat surface and size	-	-	2.89
High yielding	2.40	3.92	3.00

Vegetative Mutants

Leathery leaf mutant - These mutants were isolated from M_1 and M_2 generation after gamma rays and 0.2% EMS treatments. These mutants which possess dark green cotyledons were identified at the seedling stage. The leaves developed at later stage were also dark green. These mutants (Fig. 5) were characterized by the presence of abnormal leaf texture. The leaf texture was leathery and smooth and hence the name, 'leathery leaf mutant'. Growth was inferior to normal. They exhibited true breeding nature.

Drooping leaf mutant - Drooping leaf mutant was isolated from the gamma irradiated population in M_2 and M_3 generation. The leaves were not flat as normal but drooped towards lower side (Fig. 1).

Abnormal leaf type - Two mutants were isolated from 0.2% EMS for their modification in different leaf characters. The mutants possessed fused leafy lobes and increased number of palmate lobes. The leaves were thin and smooth. They exhibited true breeding nature.

Dwarf mutant - A dwarf mutant was observed in a large population of MC treatments with increased internodal regions. The leaves were irregular with 2-6 lobes. Interestingly the leaves did not resemble the palmate leaf structure. The number of leaves on the entire plant was completely reduced. The mutants produced small fruits.

Sterile mutant - A complete sterile mutant was isolated from 0.02% of MC treated population. The mutant plant was dwarf with small palmate leaves. The mutant did not produce the flowers either male or female even up to the harvesting period. Morphologically, the leaves were slender and delicate. The non flowering character resulted in producing the increased number of tendrils. Other than these characters it was completely normal.

Semi sterile mutant - These plants were isolated from all the mutagenic treatments with different magnitudes. The morphology of these mutants were apparently similar with the control. These plants exhibited a peculiar phenomenon where a very few flowers were able to produce fruits. Some of the flowers from these mutants exhibited abnormal development of gynoecium and androecium.

Floral Mutants

Different types of mutations affecting floral organs were observed after mutagenic treatments. Considerable increase in flower size and multiplication in the number of floral organs were observed. The floral abnormalities mainly consisted of :

i) Production of bisexual flowers.

ii) Variation in the petal and sepal number such as the presence of 5-7 petals and sepals per flower in place of 5 (Fig. 6 & 7).

iii) Adnation of petal with stamen.

iv) Sterility of some anthers.

Early flowering mutant - From treated populations of all mutagens used in the present investigation, several early flowering mutants were isolated. In these plants the flowering character might have been stimulated due to the mutagenic treatment; ultimately resulting in reduction of 10-20 days, when compared to normal plants. The early flowering mutants however, poor in vigour and showed reduced leaf size, fruit and seed number per plant in comparison to the control. Most of the early flowering mutants showed a slight reduction in the yield. However, some of them exhibited higher yield than the control and hence could be of practical significance. These mutants were isolated in M_2 and established in further generation.

Trimonoecious mutant - Four trimonoecious mutants were isolated from gamma irradiated populations. In trimonoecious mutant plant, bisexual, pistillate and staminate flowers were present. A normal plant produce unisexual flowers without any abnormalities. The bisexual flowers which were also called 'perfect flowers' (Fig. 8), could not fertilize as vigorously as the normal unisexual flower. But a low percentage of fruit (Fig. 2, left side) setting was recorded. Finally, reduced number of seeds were observed in each fruit. Further these seeds were able to germinate normally. But the plants could survive for few days and died later on.

Bifid stigma mutant - All the Cucurbitaceae members possessed the flowers with trifid stigma. But in the present investigation, a flower with bifid stigma was isolated from EMS treated populations. These flowers produced bicarpellate ovary.

Mutations Affecting Fruit Character

Olive green fruit mutant - The variety under investigation was coimbatore long white. During the observation a dark green fruit mutant was isolated from EMS treated populations (Fig. 9). The dark green fruits were smaller in size. *M. charantia* L. produce the tenderils in extra

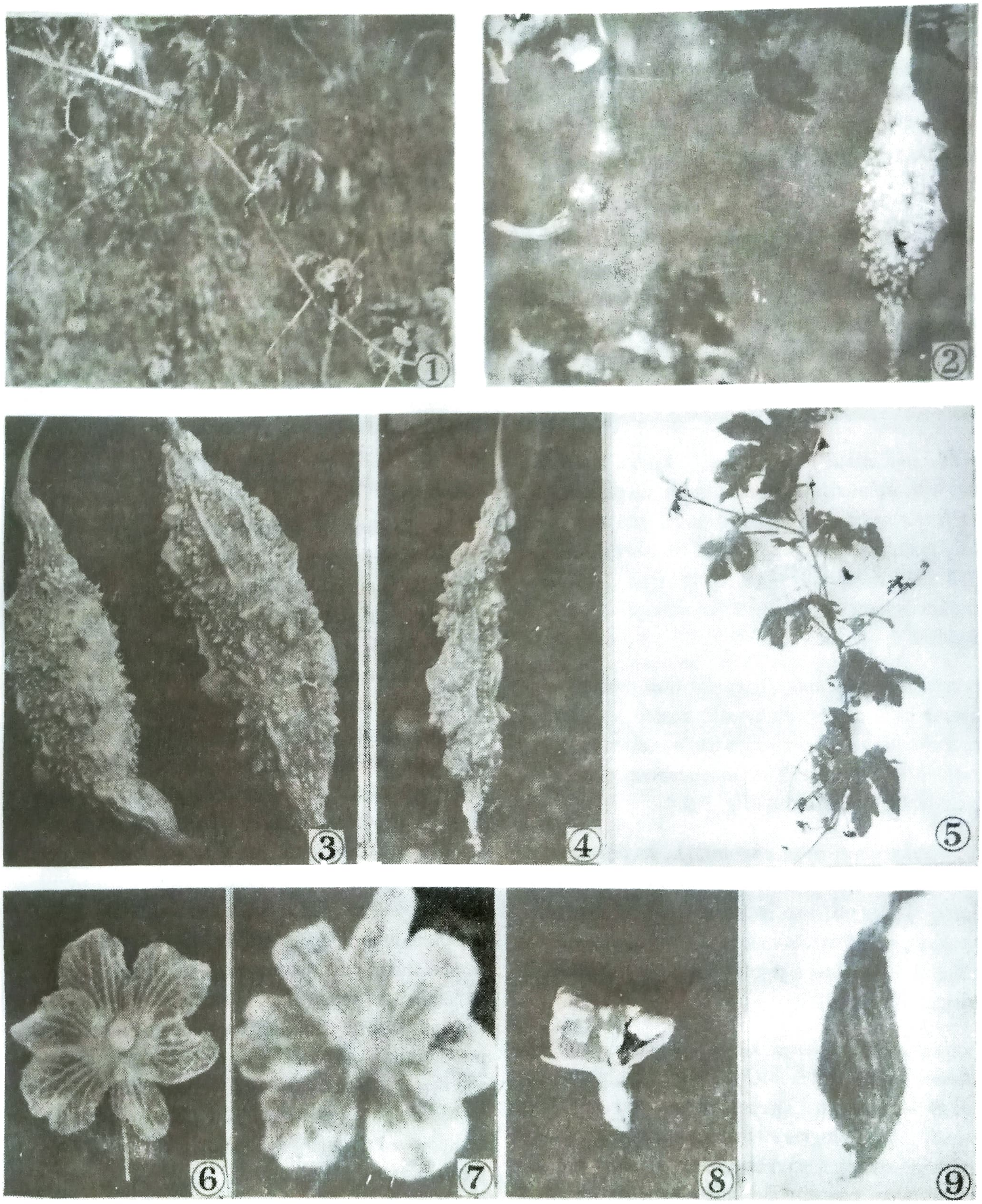

Fig. 1. Drooping leaf mutant. Fig. 2. Fruit developed from perfect flower (left) control fruit (right). Fig. 3 & 4. Irregular fruits. Fig. 5. Leathery leaf mutant. Fig. 6 & 7. Flowers with six and seven petals against normal five petals. Fig. 8. Perfect flower. Fig. 9. Olive green fruit.

axillary position. But in this particular mutant it was found that the tendrils were axillary in position.

Long fruit mutants - During the mutagenic studies, long fruit mutants were isolated from *M. charantia* L. after different mutagenic treatments. The yield was reduced significantly. The fruit length was increased 15-25 per cent when compared to normal and fruit diameter was reduced.

Stout fruit mutant - These mutants were isolated from MC treated populations. Fruit yield was significantly reduced. Fruit length was reduced slightly, but the diameter increased considerably. Fruit weight was also enhanced in these mutants. These mutants revealed true breeding behaviour in subsequent generations indicating the monogenic recessive nature.

Round and small fruit mutants - Round and small fruits were isolated from gamma irradiated populations. The fruits were so round and small and they were easily comparable to the fruits of *Momordica dioica*. Yield was considerably reduced. The fruit character of the mutant plants was confirmed as monogenic recessive behaviour to normal.

Irregular fruit mutants - Irregular fruit mutants were isolated from all the mutagenic treated populations. The fruits were irregular which had no definite shape as observed in control. The ornamentaton of the fruit was completely deformed (Fig. 3 & 4).

Fasciated mutant - In *M. charantia* L. the flowers were produced at different nodes but not continuous. Fasciated mutant was isolated from EMS treated populations. In this particular mutant successive nodes produced flowers as a result of it the yield increased considerably.

Mutated seed coat surface and size - One plant was isolated from 0.02% MC treated populations for change in seed coat ornamentation and size from normal. Morphologically these mutants were similar to control except in seed coat ornamentation and size (smaller than control) the smaller seeds were dark brown in colour which were different from normal seeds.

High yielding mutants - High yielding mutants were isolated from all the mutagenic treated populations of M_2 generations.

In the M_2 generation 30 kR of gamma rays produced a plant with greater number of fruits and the same plant in the next generation continued to show this character.

With 0.2% EMS treatment a plant with bigger sized fruits was observed in the M_2 generation and it continued to show its true breeding nature in the next generation.

MC treatments also produced high yielding mutants. Increase in the yield may be attributed to fasciation. The fasciation gene 'f' might have acted as a stimulus and resulted in high prodution. The seeds from M_2 generation were further allowed to grow in M_3' from the M_3 it was clearly confirmed that the plants were high yielding.

A number of mutations in morphological characters were reported isolated by various scientists. Sahib & Abraham (1972) found various narrow & leathery leaf mutants in X-irradiated chilli plants. Roy *et al.* (1971) noted inhibition of growth in *Cucumis sativus* after X-radiation. Bisaria *et al.* (1975) and Kaushik & Singh (1979) also observed stimulation of vine length at lower doses. Thanaki *et al.* (1970) correlated inhibition at higher doses of mutagens due to damage of nucleic acids by high energy radiation. Days to flowering was an important character that could be affected by radiation. Decreased fruit length was observed by Kumar (1978) in *Nigella sativa*. EMS was reported to reduce the seed set because of both haplontic and diplontic sterility (Sato & Gaul 1967). Seed fertility decreased with increased doses of radiation was reported by Katiyar & Roy (1976) in *Cucumis sativus*. Some of the mutants isolated in the present study were exhibiting negative selection value and these might be useful only to the plant breeder in hybridization programmes. But a few mutants could be improved through selection by eliminating some of the undesirable characters.

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Table 2: Observations on some quantitative characters of important isolated mutants of *M. charantia* in the M_3 generation

Plant type	Length of vine (cms)	No. of days to produce first male flower	No. of days to produce first female flower	Length of fruit (cms)	No. of seeds/ fruits	Seed fertility (%)
Control	210.00	35.25	41.00	23.00	25	95
Leathery leaf	126.38	46.21**	52.32*	21.42	24	68
Drooping leaf	112.00**	43.93**	52.00*	19.32	22	79
Dwarf	42.00**	40.33	61.30	13.42**	18	59
Early flowering	212.20	26.32	38.03	21.42	29	92
Trimonoecious	210.30	29.62*	36.34	20.19	21	43
Bifid stigma	182.35**	33.67*	39.38	24.42	24	40
Olive green fruit	156.30	34.88	42.00	21.42	23	79
Long fruit	218.88**	30.32	52.32*	19.53	32	92
Irregular fruit	143.39	29.67	61.22	16.47**	16	69
Fasciated fruit	188.33	39.52	59.12**	26.36*	32	89
Seed coat surface and size	134.42	42.50**	45.31	22.42	38	82
High yielding	226.36*	32.39	38.23	27.84*	45	96

*Significant at 5% level; **Significant at 1% level

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