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Induced Viable Mutations in IR 8 Rice

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In a study of induced mutagenesis in IR 8 rice a total of 467 viable mutants has been isolated. A linear trend of increase in the frequency of viable mutations with increase in dosage of the mutagens was observed. Mutants affecting grain size and duration were more commonly induced by gamma irradiation whereas, mutations affecting panicle and duration were found in greater proportions in EMS treatments.

Many viable mutants were reported by several investigators in Rice. In the present study, the frequency, spectrum and description of a large number of viable mutants obtained on induced mutagenesis in IR 8 with gamma rays and ethyl methane sulphonate are discussed.

MATERIAL AND METHODS

Unhulled seeds of rice strain IR 8 were treated with 20 to 50 kR of gamma rays enhancing 5 kR between doses and at concentrations of 50, 75, 100, 150 and 200 mM of EMS.

Seeds were soaked in distilled water for 16 hours before EMS treatment. From each M_1 plant, panicles of the Primary, first and second tiller were harvested separately. Seeds of M_1 plants were sown in a fieldnursery. All the seeds from each ear separate beds. Ten M_1 families selected at random under each treatment and 20 seedlings in each of the three panicles of a family were planted in the mainfield as progeny rows. The M_2 plants were observed periodically during their entire life period and viable mutations were scored on ear–progeny basis. All the visible changes were scored. These mutants were described with respect to deviations from normal plants.

RESULTS AND DISCUSSION

All mutations affecting the morphology of the different plant parts were classed as viable mutations in M_2.

(i) Frequency

The frequency of viable mutations was estimated as mutations per 100 M_1 spikes following gamma rays and EMS treatments.

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TABLE I Frequency of viable mutations in the M_2 generation

Mutagen and dose	Viable mutations		Viable Mutation per 100 M_1 spikes
	No. of M_1 spike progenies		
	Scored	Segregating	
(i) Gamma rays (kR).			
Control	30	—	—
20	30	12	40.0
25	30	10	33.3
30	30	10	33.3
35	30	11	36.7
40	30	19	63.3
45	28	22	78.5
50	27	16	59.2
(ii) EMS (mM)			
Control	30	—	—
50	30	3	10.0
75	30	3	10.0
100	30	4	13.3
150	28	6	21.4
200	30	7	23.3

In gamma irradiation, among the lower dosages tested, 20 kR gave higher frequency of mutations and this increased with increase in dosages from 30 to 45 kR and decreased at 50 kR. In EMS, the rate of viable mutations increased with increase in concentrations upto the highest dose tested. Thus, the frequencies of viable mutations showed dose proportional in treatments of gamma rays reaching the maximum near the highest dose employed. In EMS treatments, the frequencies showed linear increase upto the highest concentration. In the present study, gamma rays were found to be more effective than EMS in inducing viable mutations. Siddiq (1967) and Gopinathan Nair (1971) reported similar results in rice.

(ii) Spectrum

A wide spectrum of mutations affecting various morphological characters such as height of plant, duration, leaf, panicle and grain was observed. The percentages of different types of mutations were estimated from the total number of mutations induced by each mutagen over all the doses combined. The data are presented in Table II.

TABLE II Frequencies and percentages of different types (spectrum) of viable mutations in the M_2 generation.

Mutants	Frequency		Percentage	
	Gamma rays	EMS	Gamma rays	EMS
Stature mutants				
Stiff culm	4	—	1.1	—
Height mutants				
Dwarf	4	—	1.1	—
Semi-dwarf	18	4	4.9	4.1
Tall	4	—	1.1	—
Duration mutants				
Early	61	13	16.6	13.2
Late	31	10	8.4	10.2
Leaf mutants				
Boat leaf	2	—	0.5	—
Dark green leaf	—	1	—	1.0
Panicle mutants				
Long panicles	2	—	0.5	—
Compact Panicles	—	56	—	57.2
Grain mutants				
Bold	13	—	3.5	—
Medium	32	1	8.7	1.0
Fine	17	2	4.6	2.1
Awned	74	6	20.0	6.1
Absence of abdominal white	38	—	10.3	—
Sterile spike mutants	69	5	18.7	5.1
Total	369	98	100.0	100.0

From the gamma irradiated population, 369 viable mutants classified under fourteen types were isolated. Out of these, 174 were grain mutants, 92 mutants affecting duration and 26 height mutants. Sixty nine sterile mutants were also observed. Among the grain mutants, 38 did not possess the abdominal white in the caryopsis. Mutants with stiff culms, boat leaves and varied panicle lengths were also isolated but with low frequency.

EMS induced 98 viable mutations comprising of nine classes, out of which 56 were compact panicle mutants, 23 duration mutants, nine grain mutants and four mutants affecting height. The compact panicle and dark green leaf mutants were recorded only in EMS treated M_2 population. Among the classes of mutants isolated from EMS treatments, the number of compact panicle types was high followed by mutants with altered duration. In treatment with gamma rays, grain mutants were 47.1 per cent to the total whereas with EMS these were only 9.2 per cent. Gopinathan Nair (1971) reported higher frequencies of mutations with altered duration followed by grain type mutants after gamma irradiation and mutants affecting culm and panicle length from EMS treatments.

(iii) Types of viable mutants

a) Stiff culm mutants These mutants were characterised by alterations in the stem, leaf, tillering and panicle characters. Besides these, they were either normal in stature or semi-dwarf with thick, stiff culm, closely packed tillering and erect with broad and coarse leaves. Four mutants were isolated in this category from gamma irradiated population and all were sterile.

b) Visible mutants

These mutants represented alterations for individual single plant character.

Mutants for plant height

These ranged from dwarf to very tall ones. Four dwarfs, eighteen semi-dwarfs and four tall mutants were isolated from gamma rays treatment while only four semi-dwarfs were recorded from EMS treatments. The frequency of tall mutants was relatively low. Gopinathan Nair (1971) and Miche *et al.* (1973) reported similar results in rice. Four dwarf mutants isolated from 25 kR gamma rays treatment were distinct from the rest and were characterised by short and bushy stature, narrow leaves, thin culms and closely packed tillers. The number of productive tillers in these dwarfs ranged from 16 - 88 whereas in control the range was 1 to 25. Panicles were short and the length ranged from 9.5 to 14.8 cm. The grains were medium sized in one mutant and normal in the other three.

Mutants affecting duration

Mutants with altered duration (days to flower) were either early or

late. Several mutants affecting duration obtained in the present investigation consisted of a complete array of types ranging from early (85 days) to late (132 days) ones as against control (96 days) in gamma irradiation. In the present study, earliness was found to be more frequently induced than lateness by both the mutagens but the magnitude of lateness in late mutants was more than the earliness in early mutants. Frequent induction of lateness than earliness in rice was reported by Kawai (1963), Sato (1966) and Gopinathan Nair (1971).

Leaf mutants :

Two boat leaf mutants from gamma irradiation and one dark green leaf mutant from EMS treatment were isolated. Excepting the variations in leaf, these resembled the control in other respects.

Panicle mutants :

In treatments with gamma rays, mutants for panicle types were relatively rare and only two plants had long panicles. From EMS treatment, 56 compact panicle mutants were obtained. The panicle length ranged from 14 to 20 cm as against 12.5 to 25.9 cm of IR 8 and the spikelets were closely set. There was no variation in grain size and reduction in number of grains was recorded in shorter panicles.

Grain mutants :

Mutants for grain size isolated were either bold, medium or fine. A total of 13 bold, 32 medium, 17 fine and 74 awned grain mutants was isolated in gamma irradiated plants. One medium, two fine and six awned grain mutants were obtained from EMS treatment. Kawai (1962) and Ganashan (1970) found that short grain types were more frequent than long grain types whereas in the present study medium type grains were more common. Many grain mutants resembled control for other characters. However, some have yielded more than the control and found to contain more protein (e.g., The mean yield of control was 29.0 gm per plant with a protein content of 9.25 per cent where as the high yielding mutant No. 11/III/10 isolated from 50 kR recored 46.95 gm per plant with 12.25 per cent protein content).

The abdominal white, which is present in the caryopsis of IR 8 was found to be absent in 38 plants under gamma irradiation. These could be classified as types with grains which were either fine, medium or coarse, similar to IR 8. Most of these mutants yielded less than the control primarily because of low seed fertility. In these, mature grains were translucent.

Other types of mutants obtained included sterile spike mutants.

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REFERENCES

GANASHAN. 1970. Induced mutation studies with *Brachiaria brizantha* stapf. and some *indica* rice varieties from Ceylon. *Rice breeding with Induced mutations* II. (Tech. Rep. Series No. 102) IAEA. Vienna. 7-12.

GOPINATHAN NAIR. V. 1971. Studies on Induced Mutations in Rice (*Oryza sativa* L.) Unpub. Ph.D. Thesis submitted to the University of Madras.

KAWAI, T. 1962. The present status of mutation research and breeding in rice in Japan. *Int. Rice commn. Newsl.* **11** : 1-13.

KAWAI, T. 1963. Mutations in rice induced by radiation and their significance in rice breeding. I. Mutations by radiophosphorus. *Bull. Nat. Inst. Agric. Sci. Japan Series* D **10** : 1-75.

MICHE, A., S. C. HSISEH and B. SIGURBJORNSSON. 1973 Rice breeding with Induced mutations. 573-80 - Internat. Atom. Energy Agency, Vienna, Austria; (c. f. PBA. Vol. 43 No. 7 Abs. (5082).

SATO. M. 1966. Inductions of mutations in rice by some chemicals. *Mutations induced by R I and chemicals. Gamma Field Symp.*, 5: 71-81.

SIDDIQ. E. A. 1967. Induced mutations in relation to the breeding and phylogenetic differentiation of *Oryza sativa*. Unpub. Ph.D. Thesis, submitted to the I.A.R.I., New Delhi.