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INDUCED VIABLE MUTANTS BY COMBINED EFFECT OF GAMMA RAYS AND EMS IN RICE.

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Viable mutants were obtained both individual as well as combination treatments, the latter giving a higher frequency. Maximum mutation frequencies were obtained from 40 krad + 50mM of combination treatment. Antagonistic effect on M_1 spike basis and additive effect on M_2 plant basis were recorded by the combined effect of two mutagenic treatments. The spectrum of viable mutants produced due to combination tretaments was higher than individual treatments. Mutants for the different characters studied are discussed with reference to the single and combination treatment of mutagens.

Induced mutagenesis is an important complementary and often unique approach to plant breeding, as it has been repeatedly shown in a number of crop plants. Combination of mutagenic treatments is one of the methods employed for the enhancement of mutagenic efficiency. This approch makes use of the fact that various physical and chemical mutagens induce different spectra of mutations. Thus, radiations combined with chemical mutagens is expected to increase the mutation frequency and widen the spectrum. In the present study an attempt has been made to induce viable mutants in rice with gamma rays and ethyl methane sulphonate in single and in combinations and the results obtained are discussed.

MATERIAL AND METHODS

Dry seeds with a moisture content of 11% of the rice variety Co 37 were irradiated at 10 to 50 Krad doses of gamma rays. Seeds pre-soaked for 24 hrs. were treated with 10 to 50mM of EMS. For combination treatments the dry seeds were exposed to 40 krad of gamma rays and then presoaked for 24hr in distilled water. These presoaked seeds were then kept immersed in EMS at the concentrations of 10 to 50mM. All the seeds were sown simultaneously under field conditions.

The seeds of each panicle of 20 individual M_1 plants were selected at random in each treatments and raised as ear to progeny rows. The M_2 plants were observed periodically during their entire life period and all the visible mutants were scored. These mutants were classified on the basis of most conspicuous characters such as stature, duration, leaf, sterility, panicle and grain mutants. Viable mutant progenies were calculated on M_1 plant, M_1 spike and M_2 seedling bases. The

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overall significance of the deviation of observed values from expected in each series of combination treatments was tested by Chi-square method. If the deviation was significant, the two mutagens were considered to influence each others' action synergistically or antagonistically depending upon whether the deviation was positive or negative. Otherwise the mutagens were considered to act independantly. The interaction effects of combined treatments were also calculated according to the formula suggested by Sharma (1970).

RESULTS AND DISCUSSION

a. *Frequency*

Viable mutants were observed in individual M_2 plants by visual observation throughout the growth period. Marked difference was observed among different treatments with regard to the frequency of viable mutations.

The mutation frequency was higher on M_1 plant basis than on M_1 spike and M_2 plant bases. Increase in mutation frequency was observed as the doses of EMS and combination treatments were increased. In respect of gamma rays the frequency increased upto 40 krad and thereafter no proportionate increase was evident. Among all the treatments, maximum mutation frequencies on M_1 spike and M_2 plant basis Krad + were obtained from 40 + 50mM of combination treatment

The data on the effects of combining the mutagens on M_1 spike and M_2 plant bases are given in table 2 and 3. In the present study, combination treatments produced higner frequency of viable mutations than individual treatments of either of the mutagens. This is in agreement with the results obtained in rice by earlier workers (Charrabarti 1975). The chi - square value showed that the deviations from the expected values of viable mutants frequency on M_1 spike basis were in the negative direction indicating that the two mutagens were antogonistic in their action. This was also confirmed from the value ot the interaction coefficients.

On M_2 plant basis, deviation was not found to be significant and indicated additive effect in most of the combination treatments. The interaction coefficients also confirmed the additive effect in combination treatments except 40 krad+50mM treatment where the effect was synergistic.

Mohan Rao (1972) suggested that the additive effect observed in combination treatments of two mutagens to be due to the independent action of the two mutagens in inducing mutations, probably by different mechanisms. Chakrabarti (1975) proposed that the additive effect of combination treatments might be due to the fact that one of the mutagens exposed previously protected mutation sites to the second mutagen. If two mutagens compete for the same loci or if one mutagen facilitates the enhanced action or modifies the effect of the second the mutagens applied in sequece my na produce an effect which deviates from additivity.

b. *Spectrum of viable mutations*

A broad spectrum of viable mutants affecting various characters has been detected in the present Investigation. These mutants appeared in the M_2 generation, with a lower segregation ratio approximately to one forth of the family population. It is reasonable to assume that these mutation are recessive in nature. In the present experiment, a wider spectrum of viable mutants was observed in gamma irradiation than in EMS treaments population. Their frequencies were also different. The spectrum of viable mutants produced due to combination treatments was higher than individual treatments. Similar results were recorded by Chakrabarti (1975) in rice.

Among the mutants isolated for plant height, mutants with reduced height were more common in occurrence than with increased height. Similar results have been observed by Gopinathan Nair (1971) in rice. Mutants with non-tillering habit was observed only in single treatments. Stiff culm, extreme dwarf and non flowering mutants were very rare both in single and combination treatments. The relative percentage of stature mutants produced by gamma rays was higher than EMS and combination treatments.

Extreme dwarf mutants were isolated both in individual and combination treatments. In these the panicles did not emerge completely and no grain setting was noticed. Similar results have been reported by Reddy and Reddy (1973) in IR 8 variety of rice. The frequency of dwarf mutants were more in gamma rays and combination treatments. Dwarf and semi dwarf mutants have been reported by many investigators. The dwarf and semi dwarf mutants were found to be non-lodging.

Mutants possessing grassy clump were obtained only in 40 krad of gamma irradiation and not in EMS and combination treatments. These plants were short and stubby with extremely narrow, short and dark green leaves and small distorted panicles and were similar to those reported by Mahabal Ram and Zaman (1972) and Reddy and Padmini (1974).

Late and early mutants were noticed in the present study, mutants with longer duration being in excess of the early ones. In respect of leaf mutants boat-leaved mutants occurred only in gamma rays treatments. Leaf mutants altered in plant morphology with drooping flag leaf and long exerted panicles were also isolated from 30mM of EMS treatments. Mutants with white and yellow leaf variegation occurred only in individual treatments. Mutants for leaf and panicle types were comparatively less frequent in gamma irradiation whereas, panicle type mutants were more in EMS and combination treatments. Compact and long panicle types have been isolated from both the mutagens employed. Variations in panicle length have been reported by Vairavan *et al.*, (1973) with physical mutagens.

In the present study, a number of of mutants with alteration in grain size

was isolated. Mutants for grain size were reported by Gopinathan Nair (1971) and Mahabal Ram and Zaman (1972). Forty eight fine grained mutants were isolated both in individual and combination treatments. Among the grain mutants isolated red grain mutants occurred most frequently in 40 krad of gamma irradiation and not in EMS and combination treatments. Earlier workers like Mallick (1978) have reported similar results in rice. The viable mutants isolated from Co 37 represented variability in almost every character in rice plant, indicating the scope for altering any character in rice through mutations.

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Table 1 Prequency of viable mutations in the M_2 generation

Mutagen (Dose/Conc.)	Mutation frequency		
	Per 100 M_1 plants	Per 100 M_1 spikes	Per 100 M_2 plants
Gamma rays (krad)			
Control	—	—	—
10	7.91	5.05	0.59
20	8.81	5.90	0.76
30	9.30	6.85	0.89
40	10.67	8.14	1.38
50	9.72	7.62	0.83
EMS (mM)			
Control	—	—	—
10	6.88	4.63	0.45
20	7.78	4.85	0.49
30	8.30	5.32	0.56
40	9.16	6.17	0.65
50	9.26	7.96	0.80
Gamma rays + EMS*			
Control	—	—	—
40+10	10.20	6.48	1.93
40+20	10.63	7.93	2.05
40+30	11.11	8.62	2.16
40+40	13.00	9.94	2.26
40+50	13.98	11.40	2.81

* Deviations of expected frequencies from that observed were not statstistically significant