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EFFECT OF MUTAGENS ON COLD TOLERANCE IN RICE

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With a view to create variability for duration, paddy variety Intan was treated with gamma rays 20, 30, 40 Krad and Ethyl Methane Sulphonate (EMS) 100, 120 and 140 m*M* and combination treatment of 100 m*M* EMS and 20 Krad gamma rays. The M_2 was screened for cold tolerance under constant low temperature (15°C) for 10 days under laboratory conditions. In all the parameters studied, namely seedling survival with green leaves, shoot length, root length and shoot/root ratio, there was a shift in the mean to the negative side compared to untreated control. Variability for cold tolerance was more from the seed materials treated with 40 Krad gamma rays. The study indicate the possibility of selecting desirable cold tolerant plants combined with other desirable trait, duration.

Rice is a staple food for more than half the global population and is cultivated under extremes of environmental conditions. In the Cumbum Valley of Tamil Nadu during the second season (October to February) low temperature of 14°C - 16°C prevail during the month of January when flowering period of rice coincides. This results in high pollen sterility leading to spikelet sterility and consequent reduction in grain yield.

Rice variety 'Intan' is a variety reported to be promising for cool environment in Karnataka State but its duration is longer and therefore not suitable to Cumbum Valley of Tamil Nadu An investigation was carried out with a view to study the effect of two mutagenic agents namely gamma rays and EMS (Ethyl Methane Sulphonate) alone and in combination treatment to induce variability in duration without a set back to cold tolerance The present paper deals on the effect of mutagens on parameters of cold tolerance.

MATERIALS AND METHODS

The study was under taken with M_2 materials of Intan, a pure breeding variety grown in Karnataka. The M_2 materials were obtained from M_1 generation after gamma irradiation by the 1000 curie Co^{60} gamma cell 900, installed in the School of Genetics, Tamil Nadu Agricultural University, Coimbatore. The chemical mutagen EMS (Ethyl Methane Sulphonato - CH_3 SO_2 CC_2 H_5) of molecular weight of 124.16 was used for treatment of seeds.

Based on LD 50 values during germination the following treatments were taken up for the study namely

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gamma rays - 20, 30 and 40 Krad, EMS 100, 120 140 m*M* and combination of 100 m*M* EMS and 20 Krad of gamma rays.

Studies were carried out under constant low temperature (15°C) conditions in a B. O. D incubator in the laboratory adopting the method after Li *et al.* (1980). The following parameters viz., seedling survival with green leaves, shoot and root length were estimated at the end of the test period. The mean and variance were calculated for the above characters.

RESULTS AND DISCUSSION

The results of seedling survival with green leaves, shoot and root length are presented in Table. The seedling survival ranged from 27 00 to 75 09 per cent, the lowest reduction being in 40 Krad treatment. The highest reduction was recorded in the treatment EMS 120 m*M*. The variance ranged from 25.6 to 326.40.

The effect of different mutagens on various parameters viz., root length seedling height and seedling survival have been studied. Gamma rays and EMS influenced the germination and seedling survival, shoot and root length. The seelding survival was observed to be a more sensitive parameter. In the present study, the reduction in the seedling survival increased with increased dose of gamma rays and EMS In 40 Krad treatment the seelding survival was maximum, but significantly lower to control. This observation was in conformity with Bhat aud Kaul (1978) in Rice. The reduction in germination following gamma irradiation was lesser than EMS treatment and Vereschechagin (1974) reported similar results. The synergistic effects of gamma rays and EMS in the combination treatment observed in the study was similar to that of Mohan Rao (1972) in Barley.

As regards shoot length the mean values ranged from 13.26 to 19 05 cm (vide Table). The combination treatment 100m*M* + 20 Krad recorded the highest shoot length of 19.05cm with a variance as high as 2-494 as compared to the lowest variance of 0 998 in 40 Krad treatment.

In respect of root length, 40 Krad treatment recorded maximum values of 8.52cm as against the lowest of 6.47 cm in EMS 100m*M* treatment. The variance ranged from 1.72 to 27.19 (vide Table). As regards growth of shoot and root, progressive and linear retardation was recorded in Rice by Raj *et al.* (1972). The combination treatment 100 m*M* EMS + 20 Krad gamma rays recorded the maximum shoot length of 19 85 cm showing the synergistic effect of the mutagens. Similar synergistic effects were reported by Konzak *et al.* (1961) in seedling height in Barley.

In all the parameters studied, there was a shift in the mean to the negative side compared to the control. This is in accordance to the known feature of induced mutations in which the mutations generally occur towards the opposite direction of the previous

TABLE

S. No.	Treatment	Seedling Survival Mean%	Variance	Shoot length Meancm	Variance	Root length Meancm	Variance	Shoot / root ratio
1.	EMS 140 m*M*	27.00 (30.47)	160.98	13.28	3.01	6.87	4.19	2.185
2.	EMS 120 m*M*	54.00 (47.50)	326.41	14.64	2.05	6.72	3.27	2.27
3.	EMS 100 m*M*	30.25 (32.25)	232.78	13 26	2.97	6.47	2.06	2.23
4.	20 krad	63.25 (49.86)	247.21	14.45	2.23	7.52	2.09	2.02
5.	30 krad	63.75 (53.50)	84.97	13.42	1.39	7.87	1.72	1.83
6.	40 krad	75.09 (60.33)	25.65	14.29	0.998	8.52	3.54	1.80
7.	100m*M*+20krad	30.75 (32.77)	233.96	19.05	2.494	6.66	3.001	2.32
8.	Control untreated	92.00 (78.57)	--	15.8	0.539	6.00	0.399	2.66

Note : Figures in paranthesis indicate angular transformed values

selection (Goud, 1967). Intan is already having tolerance to cold as seen by the different parameters of cold tolerance in the control plants. It indicates that while attempting to induce a useful mutation on one direction, the appropriate mutagen and dose should be so fixed that the existing desirable attribute is not drastically affected. In the present study, both EMS and gamma ray treatments in the doses tried are found to drastically reduce the survival. But, there has been enhancement among the surviving plants for shoot and root length which are desirable for cold tolerance. Again the variances in survival, root and shoot growth have also been enhanced considerably compared to control. Therefore, it is possible to select desirable cold tolerant plants combined with other desirable traits such as shorter duration. A careful selection in M_3 and further generations can result in useful mutants with combination of desirable attributes without losing the cold tolerance.

Ghosh and Singh (1983) studied the effect of differant concentrations of EMS and DES (Diethyl sulphate) on husked and dehusked seeds of IR 24 rice treated for four hours and had recorded a low cold tolerance values in almost all M_2 lines compared to the control viz., Ishikari and Matsomae, two Japanese varieties. The present study was aimed to study the variability created by gamma and

EMS treatments for various parameters of cold tolerance. A wide range of variability has been created in respect of seedling survival, shoot length and root length due ro the above treatments and the treatment 40 Krad gamma rays was observed to be quite useful in spotting out desirable segregant for low temperature tolerance.

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