Res. J. *Kerala, 1973, 11 (1) 69—74*

RADIOSENSITIVITY OF RICE SEEDS OF DIFFERENT VARIETIES*

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Radiosensitivity in rice varies according to species, subspecies, varieties and genotypes. The three subspecies of *Oryza sativa* viz. *indica*. *japonica* and *javanica* show differences in sensitivity to radiations. Marked intervarietal differences in radiosensitivity were reported in varieties grown in Japan, This initial assessment of the efficiency of radiations with reference to varieties will aid in the choice of material in rice mutation breeding programmes. Such studies in varieties grown in South India have not been conducted. An attempt is therefore made to determine the differential sensitivity of rice varieties to X-rays.

Materials and methods

The important characters of the varieties of rice chosen for the present studies are presented in Table 1. Seeds were selected and stabilised for moisture content of 10 to 12 percent by keeping in a desiccator, over a saturated solution of calcium chloride, for a period of four weeks. Hundred seeds in each variety are irradiated with each of the two doses of X-rays viz. 15 and 20 k ad. Irradiation was done using a philips X-ray generator operated at 50 kV and 2 mA. Seeds were sown immediately after irradiation in a field nursery in two replications. Survival* count and seedling height measurement were made 30 days after sowing. The main ears of all surviving plants were collected and seed fertility estimated. In the M_2 generation, chlorophyll mutation frequency was estimated as number of mutants per 100 M_2 plants.

Results and discussion

The assessment of radiosensitivity in higher plants has been mostly made using different biological criteria such as germination, survil, plant growth, fertility and mutation frequency. The higher dose employed was found to be less than LD_{50} for the different criteria of M_1 damage such ss jethality, injury and sterility. Therefore a comparative evaluation of radiosensitivity of the varieties was made on the basis of effects induced by that dose (20 krad).

Part of Ph. D. thesis approved by the Tamil Nadu Agricultural University, Coimbatore,

Table I. Characters of rice varieties

Sl. No.	Name of variety	Sub-species	Stature of plants	Flowering duration (days)	Grain size		Weight of 1000 grains (g.)
					Length (mm)	Breadth (mm)	
3.	Co.29	Indica	Tall	88	8.2	2.8	23 8
2.	Co.10			88	8.4	3.1	26.0
.3.	Co. 13			87	8.2	3.0	23.9
4.	Co. 18			93	8.2	2.9	22.4
,5.	Adt.27			77	6.2	3.0	16.3
(,.	Adt.28			76	8.3	3.3	28 5
7.	Tkm.6			86	8.3	2.4	18 4
8.	Ptb.10			78	8.6	3.1	26.3
9.	Ftb 23			77	8.6	3.0	26.6
10.	Ptb.31			72	7,6	3.3	26.8
11.	Peta			112	8.7	3.0	27.3
12.	Norin-1	Japonica	Dwarf	78	7 2	3.3	23.5
I !	Norin-6			65	7.0	3.4	26.4
[4	Norin-17			69	7.1	3.5	28.0
15.	Rikku-132			67	6,7	3.4	26.7
16.	Taichung Native-1	Dwarf indica		95	7.7	3.1	25.1
17.	I.R.8			102	9.1	3.1	30.1.
[8.	Tainan-3	Tall Japonica	Tall	94	6.9	3.6	27.1
19.	Taichung-65			82	7.1	3.5	27.7
20.	Kaossiung-68			95	7.0	8.6	28.8

The percentages of survival, seedling height and seed fertility were estimated in relation to the control and presented in Table 2 These M, effects were induced in different intensities, the degree of damage in the same variety increasing in the order, lethality, injury and sterility. The frequency of chlorophyll mutations was estimated as number of mutants per 100 M_2 plants. The frequencies for the 20 varieties differed considerably with a range of 0.42 to 2.47. The vaireties exhibited differential sensitivity to x-rays irrespective of whether the criterion for comparison was a measure of M_1 damage such as lethality, sterility or an estimate of M_2 chlorophyll mutation frequency. Such intervarietal differences in radiosensitivity were recorded by Matsuo *et at.* (1958), Fujii (1962),

An examination of the morphological features of the varieties studied and their relationship to radiosensitivity revealed that an association exists between the length of grain and sensitivity. With an icrease in length of grains the M_2 sterility and M_2 chlorophyll mutant frequency increased whereas M_1 lethality showed an inverse relationship. Mikaelsen and Navaratna (1968) found that the variety with the smallest grain was the most radioresistant. However, intervarietal differences in radiosensitivity might be due to differences in genotype as reported by Matsuo *et al.* (1958), Fujii (1962), Miah and Bhatti (1968) and Narahari (1970). Differences in sensitivity of varieties even within the subspecies *Mica* being thus well expressed, it is imperative that in programmes of mutation breeding an initial assessment of the efficiency of the mutagens with reference to the varieties should be made.

Summary

Seeds of 20 varieties of *Oryza sativa* belonging to subspecies *indica* and *japonica* were irradiated with X-rays to determine varietal differences in radiosensitivity. The assesment of radiosensitivity was made by using different biological criteria such as survival, plant height, fertility and chlorophyll mutation frequency. The varieties exhibited marked differences in sensitivity to X-rays expressed as lethality, injury and sterility in the M_1 generation and chlorophyll mutation frequency in the M_2 generation. Varieties belonging to subspecies *indica* differed in sensitivity from those belonging subspecies *japonica.* The indica varieties were more resistant to X-rays when judged on the basis of lethality and injury but were more sensitive based on sterility and chlorophyll mutation frequency. Differences in sensitivity of varieties to mutagens within the subspecies *indica* were recorded. An association was found to exist between length of grain and radiosensitivity. With an increase in length, M_1 sterility and M_2 chlorophyll mutation frequency increased. However, the differential radiosensitivity might be traceable to differences in the genotypes of varieties.

Acknowledgements

The author is grateful to Dr. BWX Ponnaiya and Dr.P. Madhava Menon for their guidance during the course of this investigation.

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Intervarietal differences within a subspecies were less than the differences between subspecies *Indica* varieties were more resistant to X-rays than *japonica* varieties when judged on the basis of lethality and injury but were more sensitive when evaluated on the basis of sterility and chlorophyll mutation frequency. Such a difference based on the criteria of estimation of sensitivity was markedly exhibited by varieties of tall *japoniaa* group such as Tainan-3 and Taichung-65. Contrary to *Micas* these varieties were highly sensitive based on lethality and injury but highly resistant based on sterility and mutation frequency. Siddiq and Swaminathan (1968) also found that Taichung-65 was highly sensitive but yielded only a low mutation frequency.

Table 3. Varieties ranked in order of increasing M, damage and M_2 mutant frequency Dose - 20 krad

M_1 lethality (Survival reduction)		M_1 injury (Height reduction)		M_1 sterility (Fertility reduction)		M_2 mutant frequency (mutants per 100 M_2 plants)	
%	No£	%	No£	%	No£	%	No£
2	2*	4	2*	23.2	18	0.42	3*
2	4*	7	1*	24.4	20	0.44	14
2	10	7	4*	26.1	19	0.50	19
	16	7	6*	26.5	14	0.62	5*
3	8*	10	3	29.1		0 85	18
	15	11	7*	31.8	16	0.88	12
4	1*	11	20	31.9	3*	1.43	15
	7*	12	1	32.0	2*	1.44	17
4	9	12	17	32.7	12	1.48	9*
4	11*	11	5*	32.7	13	1.60	
	1	13	9*	39.2	4*	1.63	11*
5		13	12	39.3	9*	1.65	4*
5.	14	16	10*	40.6	10*	1.68	20
5	17	16	14	43.9	5*	1 84	16
6	5*	16	16	44.2	15	1.88	1*
6	6	16	19	46.6	8*	2 03	10
	3*	18	15	47.8	7*	2.05	6*
11	18	19	18	49.9	1*	2.10	13
15	20	21	8*	51.2	1*	2.19	8*
16	19	21	11*	52.2	6*	2 47	7*

£ Serial Nos. of varieties as in Table 1.
* *indica* varieties

Myttenaere *et al.* (1965), Mikaelsen and Navaratna (1968) and Miah *et al.* (1970). The degree of sensitivity differences between varieties depended on the criterion adopted to measure the radiation effects. In Table 3 the varieties are ranked in the order of increasing M_1 damage and M_2 mutant frequencies. It is evident that when different criteria were adopted for measuring radiosensitivity, the ranking of varieties in terms of induced effects did not exactly correspond to each other.

Table 2. Effect of x-rays in the M_1 and M_2 generations on different varieties. Dose - 20 krad

Varieties	M_1 effects (% of control; Survival (30 th day)	Seedling height (30 th day)	Seed fertility	No. Of M_2 seedlings	Mutants	Mutants per 100 M_2 plants
Co.29	96	93	48.8	5053	95	1.88
Co. 10	98	96	68.0	2943	47	1.60
Co. 13	91	90	6S.1	1688	·	0.42
Co.18	98	93	60.8	2186	36	1.65
Adt.27	94	87	56.1	5018	31	0.62
Adt.28	94	93	47.8	2776	57	2.05
Tkm.6	96	89	52.2	2269	56	2.47
Ptb.10	97	79	53.4	2192	48	2.19
Ptb.23	96	87	60.7	3047	45	1.48
Ptb.31	98	84	59 4	2120	43	2.03
Peta	96	79	50.1	2139	35	1.63
Norin-1	95	87	67.3	2513	22	0.88
Norin-6	96	88	67.3	2851	60	2.10
Norin-17	95	84	73.5	2513	11	0.44
Rikku-132	97	82	55.8	1614	23	1.43
Taichung Native-1	98	84	68.2	3158	58	1.84
I.R.8	95	88	70.9	3606	52	1.44
Tainan-3	89	81	76.8	4579	39	0.85
Taichung-65	84	84	73.9	3800	20	0.50
Kaohsiung-68	85	89	75.6	5120	86	1.68

Many investigators have stressed the higher radiosensitivity of *japonica* varieties (Fujii, 1962; Yamaguchi, 1964; Swaminathan *et al.*, 1970). In the present study, the varieties belonging to subspecies *indica* were found to differ in radiosensitivity from those belonging to subspecies *japonica*

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(M.S. *received on 15-10-1973*)