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FREQUENCY AND SPECTRUM OF GAMMA RAY INDUCED VARIATIONS IN THE WEIGHT OF EARS IN RICE VARIETY JAYA

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Induced mutations have already proved beneficial for tailoring better varieties of crop plants. Variations induced by mutagens have been extensively studied and reported in a number of crop plants especially in seed propagated ones. In the course of a detailed investigation on gamma ray and Ethylmethane sulphonate (EMS) induced polygenic mutations in rice variety jaya, the authors studied the nature of induced variations in various polygenic traits. The present paper deals with variations induced by gamma rays in the weight of ear. The work was carried out at the Department of Botany, University of Kerala, Trivandrum during the year 1971—74.

Materials and Methods

Dry and pure seeds (moisture content 12%) of rice variety jaya were subjected to 60 Co-gamma irradiation at 10, 20 and 30 kR exposures at BARC, Bombay. Ten days after irradiation, the twenty four hours soaked treated and control seeds (300 nos. each) were germinated in moist petridishes. The sprouted seeds were sown in nursery and on the 25th day they were transplanted in the main field in singles with three replications in RBD. The tillers of the M_1 plants were serially numbered up to the sixth tiller based on the sequence of emergence. In cases where the number of panicles exceeded six, all the remaining panicles of each plant were also harvested and bulked to form the seventh group. The above seven groups from each of the M_1 plants were sown as separate panicle progenies in RBD with three replications. On the 25th day, a maximum of 25 seedlings per panicle progeny were transplanted in the main field. In M_3 also uniformly collected seeds from each M_2 panicle progeny (maximum of 25 seeds per progeny) were grown and studied. The weight of ear per plant, excluding the border ones and morphologically abnormal ones were studied in M_2 and M_3. Based on the weight, they were grouped under three phenotypic categories ie (1) Plants falling in the negative side of control (below 3 g.) (2) Plants falling in the control group (3-6 g.) and (3) Plants falling in the positive side of control (above 6 g.).

The mean weight of ear and phenotypic frequency distribution dose wise and M_1 ear wise and analysis of genetic parameters were carried out both in M_2 and M_3.

Results and Discussion

Gamma ray exposures resulted in a significant *reduction* in mean weight

of ear in M_2 and M_3 (Table 1) to control. Both in M_2 and M_3 there were no significant difference between the three exposures. Comparing the two generations there were significantly higher values in M_2 only in 10 kR exposures. Mean weight of ear did not significantly differ in the seven panicle categories or in the interaction of treatments with panicle categories, either in M_2 or in M_3. Both in M_2 and M_3 the maximum and minimum values were found to be distributed in different panicle categories.

Table 1

Mean **weight of** ear **induced** by gamma **ray under the** M_1 panicle categories

M_1 panicle category	Mean weight of ear in M_2				Mean weight of ear in M_3			
	10 kR	20 kR	30 kR	Control	10 kR	20 kR	30 kR	Control
1	2.57	2.75	2.70	4..27	2..93	3..25	2.90	4.27
2	2.97	2.49	3.09	4,.13	3.31	2.,10	3.33	4.13
3	2.92	2.94	3.21	3.97	3.54	3.20	3.10	3.97
4	3.12	3.02	2.89	4.07	2..93	3.30	3.32	4.07
·	3.27	2.79	2.81	3.77	3.00	3.02	3.50	3.77
6	2.75	2.75	2.83	4.17	3.00	3..07	3.30	4.17
7	2.32	3.16	3.17	4.33	3.33	3.45	2.83	4.33
Mean	2.87	2.84	2.96	4.10	3.15	3.06	3.18	4.10

	M_2	M_3
Mean square between treatments	7.86*	7.52*
Mean square between panicle catecgories	0.07	0.08
Mean square between interactions	0.31	0.15
Critical difference between treatments	0.21	0.24
Critical difference between generations.	0.22	

*Significant at 5% level.

The phenotypic frequency distribution of ear weight mutants induced by gamma rays is represented in Table 2. The analysis of variance showed significant variation both in M_2 and M_3 for negative mutation frequency. Bothin M_2 and M_3, highest yield of negative mutants were noted under 20 kR with significant differences between the exposures. Significantly higher values were noted in M_2 compared to M_3 in all the three exposures studied. Significant variation in the frequency of positive mutants were not observed in M_2. Both in M_2 and M_3 the yield of positive mutants showed a slight linear increase with increase in exposure level. When 10 and 20 kR exposures showed a significant decrease in the yield of

Table 2

Phenotypic distribution of ear weight in M_2 and M_3

Generations	Exposures	No. of plants analysed	No. of plants in each group: Negtive group	Control group	Positive group	Percentage in each group: Negative group	Control group	Positive group
	10 kR	6125	1222	4117	786	19.96	67.21	12.83
M_2	20 kR	5855	1349	3723	783	23.05	63.58	13.37
	30 kR	5555	1116	3623	816	20.10	65.22	14.68
	10 kR	6125	951	4506	668	15.52	73.56	10.92
M_3	:0 kR	5855	1029	4145	6S1	17.57	70.79	11.64
	30 kR	5555	735	3960	870	13.05	71,28	15.67

		M_1	M_2
Mean square	Negative group	21.94*	16.25*
	Control group	24.58*	19.65*
	Positive group	3.24	96.86*
Critical difference	Negative group	1.16	1.19
	Control group	1.42	0.87
	Positive group		2.02

*Significant at 5 per cent level.

positive mutants in M_3 compared to value in M_2. 30 kR exposures showed a little higher

The chi-square test to find out the **heterogenity** in the distribution of different panicle weight mutants under the seven M_1 panicle categories showed no significant variation. The phenotypic frequency distribution under the seven M_1 panicle categories (Table 3) induced by gamma ray showed no significant differences among the panicle categories or in the interaction of treatments with panicle categories both in M_2 and M, either for negative or positive mutations. The maximum frequencies of negative mutants in both M_2 and M_3 under the three exposures were met with in the early emerged panicles. In general, the higher frequencies of positive mutants were also found to be distributed in the early emerged M_1 panicles.

Gamma rays significantly reduced the weight of ears in M_2 and M_3 generations. A similar reduction in mean value has been reported by Brock (1965),

Table 3

Phenotypic distribution of ear weight under the seven M_1 panicle categories

Exposures	M_1 panicle categories	M_2 Negative group	M_2 Control group	M_2 Positive group	M_3 Negative group	M_3 Control group	M_3 Positive group
10 kR	1	20.65	66.08	13.27	14.98	74.44	10.58
	2	19.07	68.81	12.12	14.68	73.54	11.78
	3	20.60	66.30	13.10	13.88	74.39	11.73
	4	19.61	67.87	12.52	13.51	75.32	11.17
	5	20.20	66.40	13.40	13.04	76.03	10.93
	6	39.26	68.34	12.40	13.06	76.16	10.78
	7	20.17	66.82	130!	11.69	78.36	9.95
20 kR	1	22.91	63.96	13.13	14.69	75,15	10.16
	2	24.49	60.78	14.73	13.46	74.16	11.38
	3	22.97	63.03	14.00	14.09	75.71	10.20
	4	23.76	62.71	13.53	12.94	75.84	11.22
	5	22.43	65.14	12.43	13.08	75.62	11.30
	6	21.55	65.56	12.89	12.74	77.07	10.19
	1	23.07	64.16	12.77	12.25	77.11	10.64
60 kR	1	19.40	66.13	14.47	13.29	73.11	13.60
	2	21.86	63.61	14.53	13.13	74.08	12.79
	3	20.34	63.58	16.08	12.65	74.40	12.95
	4	20.50	65.57	13.93	12.05	75.36	12.59
	5	19.35	66.08	14.57	11.45	75.76	12.79
	6	19.08	67.13	13.79	11.88	76.20	11.92
	7	20.24	64.34	15.42	10.34	77.46	12.20

	Mean square					
	Nagative group		Positive group		Control group	
	M_2	M_3	M_2	M_3	M_2	M_3
Between panicle categories	2.14	4.10	1.52	1.18	1.67	5.27
Between interactions	1.83	1.78	1.17	0.50	2.14	2.75

The treatments and their interactions are not significant.

Scossiroli (1964) and Gaul (1967) in wheat. In detailed studies performed by Scossiroli *et al.* (1966) on wheat this effect was shown in the same population on a large number of characters. Gaul (1970) has pointed out that in most instances the mean values of mutagen treated populations are lower than the untreated populations. In the present study all the three exposures showed a significant

reduction in ear weight in M_2 compared to M_3. Contradictory to this Gaul (1970) has observed that the mean of generations decreases in later generations. According to him the effect of radiations on the means is due to detrimental mutations which occur more frequently than favourable ones, and which are selected against in the subsequent generations. Analysis of the data on the effect of the mutagen under the seven M_1 panicle categories for mean values showed no significant differences M_2 and M_3. This is in conformity with the result of Frydenberg *et al.* (1964) in the effect of gamma rays and X-rays on barley and Iqbalkhan and Doll (1968) in wheat after EMS treatments and Nayar and Ninan (1964, 1977) in gamma ray and EMS treated rice variety jaya.

It has been noted that the segregations of phenotypes fall both in negative and positive directions. Bateman (1959) and Oka *et al.* (1958) found that the induced genetic changes are unidirectional and negative. According to Matsuo and Onozawa (1961) and Yamagada (1964) in most such experiments, the characters usually considered have been few, resulting in more or less one pattern of distribution. But Gregory (1965) reported that in quantitative characters for fitness the number of plus effects and minus effects are essentially equal.

As may be seen from Table 2, 20 kR induced a significant increase in frequency of negative mutants compared to 10 and 30 kR both in M_2 and M_3. But the maximum values for positive mutants were met with in 30 kR exposures both in M_2 and M_3. Gaul (1970) has reported that the relation between increase of variance and dose is not linear, when a wide range of doses are used, the intermediate dose induces larger variation. Effect of mutagens under the seven M_1 panicle categories on the distribution of both negative and positive mutants showed that there is no significant differences among the panicle categories. This supports the results of Frydenberg *et al.* (1964) on barley using gamma rays and X-rays and Iqbalkhan and Doll (1968) in wheat after EMS treatment. It was interesting to note that, even though there is no significant difference between the seven M_1 panicle categories, high frequencies were found in the early emerged panicles. This clearly shows that for this particular character a detailed analysis of the early formed M_1 panicle progenies will surely give a fairly good percentage of both negative and positive mutants.

Analysis on genetic parameters showed that the difference between phenotypic and genetic coefficient of variation were so negligible. This clearly suggest that the enviornment has only very little influence and the mutagen has induced a wider variability. The analysis of heritability and genetic advance showed higher values in respect of ear weight both in M_2 and M_3. This suggests that inprovement in yield through gamma ray irradiation ts possible in the case of weight of ear.

Summary

The relative magnitude of induced variability in the weight of ear was

assessed after treating dry seeds of rice variety jaya with 10, 20 and 30 kR exposures of gamma rays. The treated population showed a significant reduction in mean value both in M_1 and M_2 without any significant differences between the seven M_1 panicle categories. Studies on the phenotypic frequency distribution of the mutants in M_1 and M_2 showed bidirectional shift compared to control. The analysis of variance showed significant variation both in M_1 and M_2 for negative mutation frequency. Both in negative and positive mutation frequencies there were no significant differences among the seven M_1 panicle categories. As there is a reduction in segregation values in later generations it is better to have selection for desirable mutants in M_1 than in M_2. The higher values both in genetic advance and heritability observed in this study suggest that improvement through gamma ray irradiation is possible in this particular character.

സംഗ്രഹം

ഗാമാരശ്മി പ്രസരണംമൂലം (10, 20 and 30 kR) ഭാരമേറിയ നെൽക്കതിരുകളോട് കൂടിയ സന്തതിപരമ്പരകളെ സൃഷ്ടിക്കുവാനായി 'ജയ' എന്ന ഭിന്നസ്ഥപയോഗിച്ച് നടത്തിയ ഒരു പഠനത്തിൽ, രണ്ടാമത്തേയും മൂന്നാമത്തേയും roieja)o<a>g1<3?>6ിൽ കൂടുതൽ ഭാരമുള്ള കതിരുകളോടുകൂടിയ സന്തതികളെ ലഭിക്കുകയുണ്ടായി. അതേസമയം രശ്മിപ്രസരണമേല്പിക്കാത്തവയിൽ 3–6 ഗ്രാംവരെ മാത്രമേ ലഭിച്ചുള്ളൂ. രണ്ടാം തലമുറയിലെ സന്തതികളും 3-ാം തലമുറയിലെ സന്തതികളെ അപേക്ഷിച്ച് കൂടുതൽ വ്യത്യയീഭാവം പ്രദർശിപ്പിക്കുന്നതായിട്ടാണ് അനുഭവപ്പെട്ടത്. ഗാമാരശ്മി പ്രസരണമേല്പിച്ചതു നെല്ലിന്റെ കതിരിനെ ഭാരത്തിൽ ഗണ്യമായ വർദ്ധനവുണ്ടാക്കുമെന്നും അതുമൂലം കൂടുതൽ ഉല്പാദനശേഷിയുള്ള ഇനങ്ങളെ തെരഞ്ഞെടുക്കാമെന്നും ഈ പഠനം വെളിപ്പെടുത്തുന്നു.

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