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Radio Sensitivity Studies in Green Gram (*Vigna radiata* (L.) Wilczek)

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The results of gamma irradiation of five varieties of green gram at 25 kR have indicated that variation in mutagenic sensitivity exists among different varieties and doses in M_1 generation. The variety PS. 7 was found to be more sensitive than the others. Significant differences were noticed between doses also. Genotypic differences were noticed in the expression of chlorophyll mutations in the M_2 generation. The variety PS-7 which was highly radio-sensitive in M_1 generation yielded the highest frequency of chlorophyllmutations in the M_2 than the other varieties studied.

A study of mutagenic sensitivity is a pre-requisite for initiating practical mutation breeding programme in any crop plant. The sensitivity of seeds to mutagenic treatments is dependent on many factors of which the genetic constitution of the varieties plays an important role. Comparison among varieties of tomato by Bianchi *et al.*, (1963), in barley by Mikaelsen and Brunner (1968), in rice by Soriano (1971), in soybeen by Ukai and Yamashita (1968), and in pea by Mujeeb and Siddiqui (1973) showed variation in response to radiation among different genotypes indicating the influence of genetic factors on radiosensitivity (Saric, 1961; Blixt, 1968 and De Nettan Court and De Vreux, 1969). Since varieties of a crop species may differ in relatively a few hereditary traits, differences in their response to radiation may be associated with a factor or factors governing such trait or traits.

MATERIALS AND METHODS

Five varieties of green gram viz. No. 305, PS. 7, G. 65, SSM. 1 and T. 44 were taken up for the present study. Gamma irradiation was done with CO^{60} gamma cell (1,000 curie delivering at the rate of 3.9 rads/minute) installed at the Tamil Nadu Agricultural University, Coimbatore. The seeds of these five varieties were treated with 25 and 50 kR. One hundred and eighty seeds with the moisture content of 11 per cent were treated with each dose and were sown in a randomised block design along with control with three replications during summer, 1974. Germination counts were made on 8th day,

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while survival of the seedlings and seedling height were recorded on the 30th day after sowing. The percentage values of germination and survival were transformed into angular sine values and analysed. The M_1 plants were harvested individually and carried forward to M_2 generation. The frequency of chlorophyll deficient M_2 seedlings was scored when the seedlings were 4 to 10 day old.

RESULTS AND DISCUSSION

M_1 generation: The observations on germination, survival and seedling height are given in Table I. The percentage of germination (transformed) ranged from 51.38 in the variety PS.7 to 72.54 in by No. 305. Significant differences existed among the varieties. There was negative linear relationship between in dose and germination. The interaction between variety and

TABLE I. Effect of gamma rays on germination, survival and plant height in the M_1 generation

Particulars	Germination % (transformed)	Survival % (transformed)	Plant height (cm)
Varieties			
PS. 7	51.38	44.48	9.76
No. 305	72.54	61.05	12.09
T. 44	68.04	56.84	10.36
SSM. 1	66.72	43.11	7.39
G. 65	67.53	49.63	7.74
'F' value	16.21**	24.13**	19.22**
SE	1.82	2.49	0.44
CD	5.22	7.15	1.27
Doses			
Control	67.93 (100.00)	54.37 (100.00)	10.12 (100.00)
25 kR	67.11 (97.47)	46.68 (90.05)	9.37 (93.25)
50 kR	59.19 (85.09)	40.22 (72.93)	7.85 (77.54)
'F' value	14.08** —	16.26** —	13.70** —
SE	1.29 —	1.76 —	0.21 —
CD	3.70 —	5.05 —	0.89 —
Variety x Dose interaction			
'F' value	3.07** —	0.82^{NS} —	0.90^{NS} —
SE	3.15 —	4.30 —	0.76 —
CD	9.05 —	— —	— —

** Significant at 1% NS: Not significant

In parenthesis: (expressed as % over control).

TABLE II. Effect of gamma rays of germination (interaction of variety and dose) in the M_1 generation

Varieties	Dose					
	Control		25 kR		50 kR	
	Absolute (transformed)	Relative	Absolute (transformed)	Relative	Absolute (transformed)	Relative
PS. 7	61.5	100.0	52.5	81.6	40.2	54.0
No. 305	68.7	100.0	81.5	112.8	67.4	98.3
T. 44	77.9	100.0	64.8	85.7	61.5	87.5
SSM. 1	68.6	100.0	70.7	102.9	60.9	88.1
G. 65	69.7	100.0	67.2	96.6	65.7	94.4
SE	3.15					
CD	9.05					

dose was significant and are presented in Table II. The reduction was drastic in PS. 7 while there was no reduction in No. 305.

In the case of survival, there was significant differences among varieties. The variety PS. 7 was more sensitive than the others. The survival of seedlings showed a decline with increase in dose. But the variety and dose interactions were not significant. Significant differences noticed among the varieties in the case of reduction of seedling height. The seedling height got reduced with increase in dose and there was no significant interaction between varieties and doses.

M_2 generation : The frequency of chlorophyll mutations are presented in Table III. The rate of mutation was, in general, higher when expressed as percentage on M_1 plant progeny basis than on the basis of M_2 seedlings. The observation indicated a tendency for increase in the frequency of mutation as the dose increased except in the variety T. 44 where the reverse was the case. The frequency of mutations expressed on M_2 seedling basis ranged from 0.15 per cent at 25 kR in SSM. 1 to 1.51 per cent in PS. 7 at 50 kR. The variety PS. 7 recorded the maximum of 27.78 per cent on M_1 plant basis and 1.61 per cent M_2 seedling basis at 50 kR. The variety SSM. 1 recorded the minimum per cent at 50 kR on M_1 plant and M_2 seedling basis.

The spectrum of chlorophyll mutations are given in Table IV. The types were *albina*, *xantha*, *viridis*, *chlorina* and others. The occurrence

TABLE III. Frequency and rate of chlorophyll mutations in M_2 generation

Variety	Dose (KR)	No. of M_1 plant progenies studied	No. of M_1 plant progenies segregating	Total population in M_2	Total No. of chlorophyll mutations	Mutation frequency	
						M_1 plant basis	M_2 seedling basis
PS.7	25	36	10	4,203	32	27.78	0.76
	50	36	10	3,437	52	27.78	1.51
No.305	25	41	2	5,348	7	4.88	0.31
	50	30	4	3,414	25	13.33	0.73
T.44	25	24	6	3,683	33	25.00	0.89
	50	24	1	2,733	11	4.17	0.40
SSM.1	25	35	3	6,755	10	8.57	0.15
	50	24	6	3,863	39	25.00	1.00
G.65	25	42	9	6,833	24	21.43	0.35
	50	24	5	3.156	32	20.83	1.01

TABLE IV. Spectrum of chlorophyll mutations in M_2 generation

Variety	Dose (KR)	Relative percentage of mutations					Percentage of mutants in mutated plants
		Albina	Xantha	Viridis	Chlorina	Others	
PS. 7	25	25.0	9.0	15.6	37.5	12.5	3.27
	50	—	11.5	38.4	19.2	30.8	6.31
No. 305	25	—	57.1	42.9	—	—	2.85
	50	12.0	36.0	52.0	—	—	5.14
T. 44	25	—	3.0	—	72.7	24.2	3.81
	50	—	100.0	—	—	—	7.28
SSM. 1.	25	—	—	10.0	90.0	—	1.68
	50	43.6	—	5.1	38.5	12.8	4.06
G. 65	25	4.2	8.3	12.5	62.5	12.5	1.77
	50	43.8	6.3	37.5	12.5	—	4.89

of *chlorina* and *viridis* was more when compared to *albina* and *xantha*. The spectrum was wide in the varieties PS. 7 and G. 65 in which all the types were observed. The spectrum was narrow in the case of T. 44, No. 305 and SSM. 1. The per cent of mutants in the mutated plants was generally low at 25 kR but increased at 50 kR, irrespective of the varieties. The variety T. 44 showed the maximum percentage while the variety SSM. 1 showed the minimum.

It appears from the data, that the variety PS. 7 which recorded relatively a much lower percentage of germination, survival and seedling height in M_1 than the others showed a higher frequency of M_2 chlorophyll mutations. On the other hand, the variety SSM. 1 that was found to be as sensitive as PS. 7 in survival percentage gave much fewer mutant seedlings than the latter variety. Significant negative correlation ($r=-0.791$) exists between the germination percent in M_1 generatien, and chlorophyll mutation frequency in M_2 generation. But no such association was noticed between the survival per plant and seedling height in M_1 and mutation rate in M_2 generation. Thus, these results have brought about a situation similar to that found earlier by Davies (1962) who recognized the multiplicity of the mechanisms involved in the radiation responses of different genotypes. Saric (1961), Blixt (1961), De Nettan Court and De Vreux (1969) and Soriano (1971) believe that radiosensitivity of varieties depends on their genetic composition.

On an overall consideration of M_1 effects and chlorophyll mutation in M_2 it may be stated that PS. 7 is more sensitive and the varieties SSM. 1 and No. 305 are the least sensitive. The mutation breeding programme in these varieties has therefore, to be oriented based on their relative sensitivity to the mutagen.

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