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MUTATION FREQUENCY AND CHLOROPHYLL MUTATIONS IN PARENTS AND HYBRID OF COWPEA FOLLOWING GAMMA IRRADIATION

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ABSTRACT

Gamma rays altering the mutation frequency and chlorophyll mutations in cowpea parents and their F_1 hybrid at different doses were studied. The mutation frequency increased gradually up to moderate doses of gamma rays and the highest frequency rate was found in the variety Co 4 on M_1 plant basis. The frequency was dose dependent. The mutant ***viridis*** was more frequent in the total spectrum, while *chlorina* and xantha were in equal proportions, followed by ***albina*** and ***albo-viridis***. The mutagenic effectiveness was higher with high doses in Co 4, and with moderate doses in C 152 as well as their hybrid. However, efficiency was maximum when calculated on lethality basis, followed by injury and sterility basis. In cowpea, 50 krad of gamma rays was found to be the most efficient dose.

Key Words: Cowpea, gamma rays, effectiveness, efficiency, mutation frequency

In cowpea (*Vigna unguiculata* (L.) Walp.), like any other species, the gene complexes of parents produce considerable variability [1, 2] in the hybrid, and subjecting the heterozygous material to mutagenic treatment can further enhanse this variability [3]. The potential physical mutagens like gamma rays cause severe reshuffling of the genetic material and induce variation of various kind in crop plants [1]. The present investigation has been taken up to analyse the mutation frequency and spectrum of chlorophyll mutations in the parent genotypes and in their hybrid in cowpea following gamma irradiation.

MATERIALS AND METHODS

Conventional hybridization using the method of rapid hand pollination were adopted for producing the hybrid seeds. The crossing was effected using the variety Co 4 as female and C 152 as male parent. The dry seeds of the two parent varieties and their F_1 (Co 4 × C 152) were subjected to irradiation of 30, 40 and 50 krad of gamma rays at the School of Genetics, Tamil Nadu Agricultural University, Coimbatore,

by ^{60}Co gamma source. Five samples of 250 seeds were taken for each treatment and control. The irradiated seeds were sown in the field along with the control in five replications laid out in factorial randomized block design. In the M_1 generation, the plants were bagged to ensure self fertilization. The M_2 generation was raised as similar to M_1 plant progenies in randomized block design in four replications. The chlorophyll mutants were scored from 3rd to 15th day after germination. Mutagenic effectiveness is investigated as a measure of frequency of mutation induced by unit does of mutagen. However, the mutagenic efficiency was also indicated by proportion of mutation in relation to undesirable effects e.g. sterility, lethality and injury. The effectiveness and efficiency were computed following Konzak et al. [4].

Table 1. Mutation frequency in M_2 generation of cowpea

Genotype	Gamma rays (Krad)	M_2 progenies			M_2 seedlings		
		total	mutated	%	total	mutated	%
Co 4	0	40	0.0	0.0	3654	0.0	0.0
	30	38	11	28.9	2946	32	1.1
	40	32	14	43.7	2555	39	1.5
	50	26	9	34.5	2239	46	2.0
C 152	0	41	0.0	0.0	3748	0.0	0.0
	30	36	12	33.3	2863	41	1.4
	40	31	14	45.2	2634	53	2.0
	50	27	6	22.2	1975	34	1.7
Co 4 × C 152	0	37	0.0	0.0	3485	0.0	0.0
	30	32	13	40.5	2762	30	1.1
	40	26	9	34.6	2149	37	1.7
	50	23	6	26.0	1840	26	1.4

RESULTS AND DISCUSSION

The mutation frequency was computed as percentage of segregating M_2 progenies segregating for chlorophyll as well as other M_2 mutants. Out of 11,394 seedlings in Co 4, 11,220 seedlings in C 152 and 10236 seedlings of their hybrid in the M_2 generation scored for chlorophyll mutations 136, 135 and 118 plants respectively. The analysis of mutation frequency calculated as percentage of mutated M_2 progenies and plants (Table 1) showed that the frequency of chlorophyll mutations increased

Table 2. Mutagenic effectiveness and efficiency of gamma rays in cowpea

Genotype	Dose of gamma rays (Krad)	Percentage survival reduction at 30 days (Lethality) (L)	Percentage height reduction at 30 days (Injury) (I)	Percentage seed fertility reduction (Sterility) (S)	Mutation per 100 M_2 plants	Effectiveness	Efficiency		
						M × 100	M × 100	M × 100	M × 100
						Kr	L	I	S
Co 4	30	14.86	2.75	10.11	1.08	3.60	7.27	39.27	10.68
	40	38.04	25.77	27.93	1.52	3.80	4.00	5.90	5.44
	50	52.54	52.13	35.96	2.05	4.10	3.90	3.93	5.70
C 152	30	13.81	16.25	6.76	1.43	4.77	10.35	8.80	21.15
	40	33.45	31.16	30.61	2.01	5.03	6.01	6.45	6.57
	50	47.27	43.59	41.09	1.72	3.44	3.64	3.95	4.19
Co 4 × C 152	30	12.14	8.81	6.13	1.09	3.63	8.98	12.37	17.78
	40	36.78	29.27	22.99	1.72	4.30	4.68	5.88	7.48
	50	45.00	39.93	29.19	1.41	2.82	3.13	3.53	4.83

with the increasing dose. The number chlorophyll mutations were higher in C 152 as compared to Co 4 and the hybrid. The frequency of chlorophyll mutations in the hybrid was higher at lower doses, while same doses induced low mutations in the parental genotypes. The chlorophyll frequency in hybrid ranged from 26.0 to 40.5% on plant progeny basis and 1.1 to 1.7% on M_2 seedling basis. The corresponding mutation rates in the parent varieties were 28.9 to 43.7% in Co 4 and 22.2 to 45.1% in C 152 on M_2 plant basis.

In both parents and its hybrid, *albina, chlorina, xantha, viridis* and *albo-viridis* mutations were recorded. The *viridis* mutant were maximum in all genotypes followed by *chlorina, xantha, albina* and *albo viridis*. These five mutants were observed at lower doses in the parent, Co 4, however *xantha* and *chlorina* were not found in hybrid at 40 and 50 doses respectively. The mutant *albo-viridis* occurred only at the lower and moderate doses in parents, Co 4 and C 152 while at the higher doses in the hybrid . In hybrid, the incidence of mutation frequency did not follow a dose dependent trend. However, mutation frequency of parents and hybrid showed a proportionate increase with increasing dose in urdbean [5].

In both the parents and their hybrid, the frequency of chlorophyll mutations showed a proportionate increase with doses of mutagen. In the present study the *viridis* mutation was highest in C 152, (64.7%), hybrid (61.5%) and Co 4 (60.9%) followed by *chlorina, xantha, albina* and *albo-viridis*.

The reason for the appearance of greater number of *viridis* may be attributed to involvement of polygenes in the chlorophyll formation [6]. The incidence of mutation frequency did not follow a dose dependent trend. The relative percentage of *chlorina* mutants ranged from 28.2 to 32.6 in Co 4, 37.7 to 41.5 in C 152, 26.7 to 37.8 in hybrid, while the *xantha* mutants ranged from 6.5 to 20.5, 4.9 to 26.5 and 20.0 to 23.0 in Co 4, C 152 and hybrid respectively. However the mutants *albina* and *albo-viridis* were maximum of 18.5 and 7.7% at higher doses in hybrid. The mutants *albina* and were more frequent in pigeonpea at lower doses in parents however in hybrid at higher doses [6].

Mutagenic effectiveness and efficiency on the basis of lethality, injury and sterility are presented in Table 2. The effectiveness for *chlorophyll* mutation did not follow a clear cut trend in parent C 152 and hybrid. In Co 4, effectiveness gradually increased upto 50 krad, while in C 152 and Co 4 × C 152, an initial increase with final decline was found. The estimates of efficiency ranged from 3.93 to 39.27 in Co 4, 3.95 to 8.80 in C 152 and 3.53 to 1237 and 21.15 respectively, at 30 krad of gamma rays in C 152. On the basis of sterility and lethality, 30 krad of gamma rays found to be the efficient dose.

In the present investigation, the induction of desirable changes free from undesirable ones was targeted. The differences were observed in efficiency of gamma rays in parents and its hybrid. The efficiency of gamma rays was reported high at lower doses of irradiation in PDU 1 and COBG 301 and at higher doses in their hybrid of blackgram [1]. Particularly in parents, an increase in mutagenic dose caused a negative trend for mutagenic efficiency. Comparatively the effectiveness was very high at middle doses in C 152 and hybrid and at higher doses in Co 4. Maximum efficiency was observed in parent C 152 in terms of sterility and lethality.

REFERENCES

1. S. Ahmed John. 1995. Effectiveness and efficiency of gamma rays in blackgram. Madras Agric. J., **82**: 417-419.
2. S. Ahmed John. 1995. Genetics of seed yield in blackgram following mutagenesis. Madras Agric. J., **82**: 428-431.
3. S. Ahmed John. 1991. Mutation Studies in Blackgram (*Vigna mungo* (L.) Hepper). Ph.D. Thesis. Bharathidasan University, Tiruchirapalli.
4. C. F. Konzak, R. A. Nilan, J. Wagner and R. J. Foster. 1965. Efficient chemical mutagenesis. The use of induced mutation in plant breeding. Radiat. Bot., **5**: 47-70.
5. S. Ahmed John. 1997. Effect of gamma irradiation on segregation ratio and mutation frequency in parents and hybrid urdbean. Madras Agric. J., **84**: 232-234.
6. S. Ahmed John. 1996. Mutation induction in parents and hybrid of pigeonpea following gamma irradiation. Madras Agric. J., **83**: 593- 595.