kg/ha, bi values of these two genotypes 0.2246 and 0.0575 respectively indicate that these are well adapted to poorer environments. Stability of yield was low for these two genotypes. Significantly low yield to SSRC-1 but on par to CO.5 was recorded by Co BG.282. Stability of yield of this genotype was high and bi value of 0.5068 indicated that this variety is well adapted to poor environments.

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EFFECTIVENESS AND EFFICIENCY OF GAMMA RAYS IN BLACK GRAM

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ABSTRACT

The effectiveness and efficiency of gamma rays in relation to induction of chlorophyll mutation in M_2 generation was made in different genotypes of black gram. The chlorophyll mutation frequency increased upto 50 krad of gamma rays and the maximum increase was recorded in hybrid COBG 301 x PDU1 followed by COBG 301 and PDU 1. The type *viridis* was found to be the maximum. The efficiency of chlorophyll mutation was high in PDU 1 on lethality basis and COBG 301 on injury basis. The efficient dose for parents was 30 krad and for hybrid 50 krad.

KEY WORDS : Gamma Rays, Effectiveness, Efficiency, Mutation, Frequency, Viridis, Chlorophyll Mutation.

Black gram (*Vigna mungo*(L.) Hepper) is one of the important pulse crops of India and it is grown mainly in dry lands. Bringing together of the gene complexes of parents in the hybrids, and subjecting the heterozygous material to irraditation produced considerable variability in black gram (Ahmed John, 1991). In recent years, physical mutagen is available for induction of mutation in cultivated plants towards improving their characters. The potential physical mutagen is known to cause severe breakdown of genetic system and induce variations in crop plants. Accordingly, the present investigation was taken up to study the gamma irradiation in parents, COBG 301 and PDU 1 and their hybrid COBG 301 x PDU 1 of black gram.

MATERIALS AND METHODS

Crossing was effected using COBG 301 as ovule parent and PDU 1 as pollen parent. Conventional crossing method as well as rapid method of hand pollination technique were adopted for producing the hybrid seeds (Rachie *et al.*, 1975). Two different crossing blocks were raised at an interval of 15 days. The dry seeds of COBG 301, PDU 1 and their F_1 COBG 301 x PDU 1 were subjected to 30 to 50 krad gamma irradiation at the School of Genetics, Tamil Nadu Agricultural University, Coimbatore, by exposting to a cobalt 60 gamma source. The emission of gamma rays from the cell at the time of treatment was at the rate of 0.286229 Million Reongent units per h. Five samples of 250 seeds for each treatment along with control were taken. The irradiated seeds were then sown in the field along with the controls. Data were gathered from five replication laid out in factorial randomised block design. In the M_1 generation, the plants were bagged to ensure self fertilisation. The M_2 generation was raised in the field on individual M_1 plant progeny basis in the randomised block design with four replications. The chlorophyll muta tions were scored from 3 to 15 day old M_2 seed lings. Mutagenic effectiveness and efficiency were calculated following the methods of Konzak *et al.* (1965).

Table 1. Viable mutation frequency in M2 generation

Genotype	Treatment dose Gamma rays (Krad)	M_1 Plants		M_2 Seedlings		Mutation Frequency	
		Studied	Segregating	Studied	Segregating	M1 plant basis	M2 Seedling basis
COBG 301	0	93	-	4654	-	-	-
	30	72	8	3646	28	11.11	0.77
	40	65	13	3252	45	20.00	1.38
	50	53	7	2657	17	13.21	0.64
PDU 1	0	95	-	4751	-	-	-
	30	68	11	3408	47	16.18	1.38
	40	64	9	3210	52	14.06	1.62
	50	59	14	2956	29	23.73	0.98
COBG 301 x PDU 1	0	87	-	4358	-	-	-
	30	62	7	3126	56	11.29	1.79
	40	57	14	2854	79	24.56	2.77
	50	40	12	2009	91	30.00	4.53

RESULTS AND DISCUSSION

The frequency of chlorophyll mutation was estimated by periodical scorings starting from 3rd day after sowing to 15th day. It was computed as percentage of plants segregating for chlorophyll deficiency on the basis of M_1 plants and M_2 seedlings. In the M_2 generation, 14,209 seedlings in COBG 301, 14,325 seedlings in PDU 1 and 12,347 seedlings in hybrid were scored for chlorophyll mutation, from 283, 286 and 246, M_1 plant progenies of respective genotypes. The chlorophyll mutation frequency calculated as percentage of M_1 plants and M_2 seedlings is presented in Table 1. The frequency of chlorophyll mutation increased with increases of mutagen. It appeared in all the mutagenic treatment in different frequencies. The mutation rate of M_1 plant basis was higher than that of the M_2 seedling basis. The chlorophyll mutants in hybrid COBG 301 x PDU 1 was higher as compared to parents COBG 301 and PDU 1. The frequency of chlorophyll mutants in parents and hybrid were high at lower doses and low at higher doses. The chlorophyll frequency in hybrid ranged from 14.52 to 35.00 per cent on M_1 plant basis and 0.96 to 2.59 per cent on seedling basis.

The spectrum of chlorophyll mutation and the relative frequencies of the different types of mutants are given in Table 2. The types *albina*, *chlorina*, *xantha*, *viridis* and *albo - viridis* were found in both parents and hybrid. In all the genotypes, the type *viridis* was highest followed by *xantha*, *albina*, *chlorina* and *albo - viridis*. These five mutant types were observed in COBG 301 at 30 krad only whereas in PDU 1 and hybrid at moderate level of 40 krad. The incidence of chlorophyll mutants did not follow dose related trend.

Table 2. Frequency of different types of chlorophyll mutants in M_2 generation

Genotype	Treatment Gamma rays (Krad)	Total Chlorophyll mutant seedling in M_2	Relative percentage of chlorophyll mutants				
			Albina	Chlorina	Xantha	Viridis	Alboviridis
COBG 301	30	38	5.26	2.63	23.68	63.16	5.26
	40	42	4.76	-	28.57	59.52	7.14
	50	51	5.88	1.96	33.33	58.82	-
PDU 1	30	36	2.78	-	33.33	61.11	2.78
	40	44	4.55	4.55	34.09	54.55	2.27
	50	48	8.33	-	37.50	54.17	-
COBG 301 x PDU 1	30	30	-	10.00	23.33	56.67	10.00
	40	41	7.32	4.88	26.83	56.10	4.88
	50	52	5.77	-	26.93	67.31	-

Table 3. Mutagenic effectiveness and efficiency for chlorophyll mutation in M_2 generation

Genotype	Mutagen dose Gamma rays (Krad)	Percentage survival reduction at 30 days Lethality (L)	Percentage reduction at 30 days Injury (I)	Percentage seed fertility reduction (Sterility) (S)	Mutation per 100 M_2 Plants	Effectiveness	Efficiency		
						M x 100 / KR	M x 100 / L	M x 100 / I	M x 100 / S
COBG 301	30	19.40	13.40	7.70	1.04	3.47	5.36	7.76	13.51
	40	33.00	31.10	14.20	1.30	3.25	3.94	4.18	9.16
	50	35.30	35.30	23.20	1.92	3.84	4.30	5.44	8.28
PDU 1	30	13.80	16.40	7.10	1.06	3.53	7.68	6.46	14.93
	40	32.20	31.30	17.40	1.37	3.43	4.26	4.38	7.87
	50	40.60	39.60	27.00	1.62	3.24	3.90	4.09	6.00
COBG 301 x PDU 1	30	20.00	18.20	9.10	0.96	3.20	4.80	5.28	10.55
	40	35.20	30.60	16.00	1.44	3.60	4.10	4.71	9.00
	50	42.00	39.70	23.50	2.59	5.18	6.17	6.52	11.20

The mutagenic effectiveness and efficiency on the basis of lethality, injury and sterility are furnished in the Table 3. The effectiveness for chlorophyll mutation did not follow a clear cut trend in COBG 301 whereas in hybrid, it increased and in PDU 1, effectiveness followed a decreasing trend. On injury basis, the estimates of efficiency ranged from 4.18 to 7.76 in COBG 301, 4.09 to 6.46 in PDU 1 and 4.71 to 6.52 in hybrid. In parents and hybrid, 30 krad of gamma rays was the efficient dose on the basis of sterility and injury.

In the present study, the frequency of chlorophyll mutation showed a proportionate increase with doses of mutagen in both parents and hybrid. These findings are in conformity with that of Ahmed John (1991) in black gram. The occurrence of different kinds of chlorophyll mutants can be represented as follows: *viridis* > *xantha* > *albina* > *chlorina* > *albo-viridis*.

The reason for greater number of *viridis* may be attributed to involvement of polygenes in chlorophyll formation (Gaul, 1964). At higher doses of the mutagen, *xantha* and *albina* occurred in higher proportion. The effectiveness showed a proportionate decrease with increase of the mutagen (Gupta and Yashvir, 1975; Ramasamy, 1973; Ahmed John, 1991). The effectiveness of gamma rays was found to be high in parents at lower doses whereas in hybrid at higher doses.

In the present study, there were differences in efficiency of gamma rays in parents and hybrid. The efficiency of gamma rays was high at lower doses in PDU 1 and COBG 301 and at higher doses in hybrid. Ahmed John (1991) found that there was a decrease in mutagenic efficiency with increase in mutagenic dose in parents. The chlorophyll mutation efficiency was high in PDU 1 on injury as well as on sterility basis. The greater efficiency of lower concentration of a mutagenic agent is due to the fact that the biological damage increases with increasing dose at faster rate than the mutation (Konzak *et al.*, 1965). The efficiency of mutagenic agent not only depends on the biological system but also of physiological damage, chromosomal aberr ation and sterility induced in addition to mutation.

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