

GAMMA - RAY - INDUCED VARIABILITY FOR DAYS TO FLOWERING AND CHLOROPHYLL MUTATIONS IN MUNG BEAN (*VIGNA RADIATA* (L) WILCZEK)

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ABSTRACT

To test the effectiveness of gamma radiation for the induction of mutations dry seeds of two mung bean varieties (G — 65 and PS — 16) were exposed to 10, 20, 30 and 40 kR dosages from a ^{60}Co source. A wide spectrum of chlorophyll mutations *albina*, *chlorina*, *xantha*, *viridis*, *chlorotica* and *virescent* was recorded in both the varieties. The total frequency ranges from 11.53 % to 21.10 % and 9.55 % to 19.50 % in the varieties G — 65 and PS — 16, respectively. However, 20 kR was found to be more effective dose to induce highest frequency of chlorophyll mutations in the two varieties. Number of days to flowering increased in PS — 16 whereas early flowering response was observed in G — 65. The values of genetic parameters increased in the irradiated material. But there was no relationship between the magnitude of irradiation and the amount of induced variability. Similar trend was observed for the estimates of heritability and genetic advance. However, this additional increase in variability would provide an opportunity for the improvement of mung bean by selection.

INTRODUCTION

Indian people are by and large vegetarian. Pulses are of immense importance because of high protein, their ability to fix atmospheric nitrogen and to enrich soil. Mung bean is recognised as a valuable pulse and is widely cultivated in India. Improvement of this crop through hybridization is laborious and recourse to mutagenesis is considered a more profitable exercise. In a mutation breeding programme, the estimates of genetic parameters provide guidelines for the improvement of quantitative characters of crop plants. Since genetic variability is limited in mung bean, induced mutations may provide an additional source of variability. Hence, an experiment was conducted following mutagenesis with gamma rays.

MATERIALS AND METHODS

Dry seeds of two mung varieties, G-65 and PS-16 were given acute exposures of 10, 20, 30 and 40 kR ($1 \text{ R} = 2.58 \times 10^{-4} \text{ C/kg}$) of gamma rays from ^{60}Co source. A sample of 150 irradiated seeds from each dose and control were sown in the field in a randomized complete block design with three replications. Each replication consisted of 5 rows of 10 seeds each. The row-to-row and plant-to-plant spacing was 60×30 respectively. Data were collected on individual plants for days to flowering.

To study the quantitative variability for days to flowering and spectrum of chlorophyll mutations in M_2 generation, a random sample of seeds from each treatment and the control was grown in randomized complete block design with three replications. The spacing was the same as in the M_1 generation. There were 6 rows of 30 plants in each replication. Observations were recorded for days to flowering on 300 randomly selected plants (least 100 plants from replication) in each treatment and equal number of plants in the control. Data were subjected to statistical analysis to assess the extent of induced variation in the irradiated population. Different treatments were compared by LSD method. Genotypic and phenotypic co-efficients of variation, heritability and genetic advance were computed according to the methods followed earlier by Khan (1983).

Chlorophyll mutations. Chlorophyll mutations were scored when seedlings were 8 to 15 days old. The frequency was calculated according to the method suggested by Gaul (1957).

“ Number of mutants/100 M_2 plants ”

Days to flowering. Number of days from the date of sowing till the date of opening of the first flower was calculated for each plant.

RESULTS AND DISCUSSION

Although chlorophyll mutations are not useful for plant breeding purposes they have been used as one of the measures of dose effect for different mutagenic treatments. Such mutations can easily be classified and scored with accuracy. A wide spectrum of chlorophyll mutants was recorded including *albina*, *chlorina*, *xantha*, *viridis*, *chlorotica* and *virescent* in different doses of gamma rays. *Albina*, *xantha* and *chlorina* were found with higher frequencies in both the varieties (Table 1). All these

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types were reported earlier by Jana (1963) in black gram. Singh *et al* (1979) and Ganguli (1981) in green gram. Earlier Dahiya (1973) reported only four types of chlorophyll mutations namely, *albina*, *xantha*, *viridis* and *masculata* after irradiation with gamma rays. However, Rao (1982) reported three more types, *straita*, *maculata* and *tigrina* with less frequencies. The frequency of chlorophyll mutations was higher at 20 kR (21.10% in G—65 and 19.50% in PS—16) and it was lower at 30 kR (11.53% in G—65 and 9.55% in PS—16). However, in general the frequency was higher and did not show a linear relationship with the doses of gamma rays in both the varieties. On the other hand, Reddy (1974) reported a linear and sometimes an exponential response to the different dosage.

The data presented in Table 2 showed that the mean values decreased as well as increased significantly ($p \geq 0.01$) in both the varieties except at 10 kR in the variety PS—16. However, these changes were not appreciable. This could be attributed to the low frequency of plants with induced earliness as well as lateness. Similar results were reported by Rajput (1974) in mung bean. A glance at the data gives an impression that mutations affecting days to flowering are not at random in the variety PS—16. This may be because the variety had not reached its peak in performance and still retained the capacity for effectively utilizing mutagenic changes in the positive way. However, the variety G—65 showed a different behaviour because of the history of selection of this variety.

The estimates of genetic parameters showed higher values for phenotypic and genotypic coefficients of variation, heritability and genetic advance. However, there is no linear relationship. Lack of a consistent dose-response relationship may be due to additional uncontrolled environmental variation, for the response to ionizing radiation is notably modified by environmental variables such as seed moisture and oxygen availability (Conger *et al*, 1966). This character is moderately heritable in this generation indicating that the success of selection will be greater in later generations. Similar results have been reported by Singh *et al* (1979) in green gram and Kundu and Singh (1982) in black gram.

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Table 1. Frequency and spectrum of chlorophyll mutations in the M_2 generation

Doses	No. of M_2 seedlings scored	No. of M_2 mutants	Relative percentage of different types of M_2 mutants						Total Frequency %	
			Albina	Chlorina	Xantha	Viridis	Chlorotica	Virescent		
Var. G — 65										
0 kR	337	—	—	—	—	—	—	—	—	
10 kR	392	74	28.38	32.43	29.73	4.05	1.35	4.05	18.88	
20 kR	417	88	28.41	25.00	31.82	9.09	2.27	3.41	21.10	
30 kR	373	43	16.28	27.91	39.53	9.30	6.98	—	11.53	
40 kR	466	79	25.32	25.32	34.18	6.33	3.80	5.06	16.95	
Var. PS — 16										
0 kR	404	—	—	—	—	—	—	—	—	
10 kR	335	60	20.00	26.66	36.67	6.67	1.67	8.33	17.91	
20 kR	318	62	25.81	27.42	32.52	6.45	—	8.06	19.50	
30 kR	398	38	28.95	21.05	42.11	—	7.89		9.55	
40 kR	327	51	25.49	23.53	33.33	3.92	3.92	9.80	18.75	

Table 2. Gamma-ray-induced variation for days to flowering in M_2 generation.

Doses	N	Mean $\pm$ S. E.	Shift in Mean	Significance Test	CVp (%)	CVg (%)	h^2 (%)	Gs (at 5%)	Gs (% of mean)
<i>G — 65</i>									
Control	300	38.02 $\pm$ 0.2351	—	—	4.91	—	—	—	—
10 kR	300	36.02 $\pm$ 0.1975	—2.00	**	7.36	5.22	59.39	2.75	7.63
20 kR	300	36.72 $\pm$ 0.2496	—1.30	**	6.92	4.69	45.99	3.17	8.63
30 kR	300	35.61 $\pm$ 0.2358	—2.41	**	7.42	5.26	50.18	3.27	9.18
40 kR	300	36.39 $\pm$ 0.2240	—1.63	**	7.03	4.81	46.76	2.89	7.94
<i>PS — 16</i>									
Control	300	35.30 $\pm$ 0.1899	—	—	4.93	—	—	—	—
10 kR	300	35.34 $\pm$ 0.1739	+0.04	NS	6.69	4.52	45.74	2.21	6.25
20 kR	300	36.46 $\pm$ 0.1990	+1.16	**	5.91	3.48	34.72	1.91	5.24
30 kR	300	36.99 $\pm$ 0.1952	+1.58	**	6.33	4.22	44.44	2.39	6.48
40 kR	300	37.36 $\pm$ 0.2107	+2.06	**	7.17	5.45	57.72	3.36	8.99

** = Significant at 1% level of probability.

NS = Non-significant