Mutation Genetic Studies in Mungbean IV. Selection of Early Maturing Mutants

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Abstract

Selection studies were conducted to reduce maturity period of two mungbean varieties. Six lines of early maturing mutants were isolated in M_2 generation after seed treatment with ethylmethane sulphonate (EMS), sodium azide (SA) and gamma rays. Morphologically stable early mutants were evaluated upto M_5 generation and compared with parental lines. High heritability coupled with high genetic advance recorded for days to maturity indicated that genetic progress to be expected from the selection. Seed yield of mutant lines was the same as in the parental varieties.

Keywords: short duration, heritability, *Vigna radiata,* ethylmethane sulphonate (EMS), sodium azide (SA) and gamma rays

Introduction

Pulses are an integral part of Indian Agricultural. As for as the yield of pulses is concerned, it is lesser than most of the cereals and millets. The low productivity of the pulses may be attributed to susceptibility to pathogenic microorganisms, asynchronous habit of pod maturity, shedding of flowers/ newly formed pods and indeterminate and long duration of growth resulting low seed yield per plant. Mungbean (*Vigna radiata* (L.) Wilczek), an important pulse crop of India, is primarily a crop of rainy season. In rainy season planting, that is, June-July, the yield of mungbean is very low as the plants are attacked by several diseases and insect pests. Development of varieties for summer season (March-April) is very important. Due to the narrow genetic base, conventional breeding methods did not contribute much to the improvement to the mungbean. Mutation breeding may be an effective tool for generating variability in the existing varieties and selecting desirable early maturing lines which would be proved to be an ideal crop for summer seasons.

Materials and Methods

A field experiment was conducted during summer (Kharif) season of 2003, 2004, 2004, 2005 ,2006 and 2007 at the Agriculture Farm, Aligarh Muslim University, Aligarh, India Two varieties of mungbean (*Vigna radiata* (L.) Wilczek) namely, K-851 and PS-16 were used as experimental materials. Healthy and uniform seeds of both the varieties were treated with 0.2% EMS (prepared in phosphate buffer pH 7) and 0.02% SA (prepared in phosphate buffer pH 3) for 6 hours. After completion of treatment period, the treated seeds were washed thoroughly in running tap water to remove the residue mutagen sticking to the seed coat. For gamma rays treatment, dry seeds were irradiated with 20kR dose of gamma rays from ^{60}Co source at National Botanical Research Institute, Lucknow. Three replications of 100 seeds each were sown for every treatment in the field in a Randomized Complete Block Design (RCBD) to raise M_1 generation. The distance between the seeds in a row and between the rows was kept as 30 and 60 cm respectively. Seeds harvested from individual M_1 plants were grown as M_2 families in

the field during Kharif season of 2004. For raising M_3 generation, 10 M_2 progenies were selected which showed significant deviations in mean values in the negative directions from the mean values of the parental varieties (control) for days to flowering and days to maturity. Selection on individual plant basis was practised in M_3 generation within the families that showed negative shift in days to maturity from the control. Progenies of each M_3 selection were grown again as families in M_4. Seeds of all plants of each M_4 family were harvested and bulked together. The bulked seeds of each family were used to grow the mutants in M_5 generation. Each mutant line and control were grown in six rows of fifty seeds each with a inter plant distance of 30 cm and inter row distance of 60 cm. Two hundred plants were randomly sampled for assessment in each mutant line. Analysis of variance was done following the method suggested by Singh and Chaudhary (1985). Genotypic coefficient of variation was determined by the formula suggested by Burton (1952) by dividing the square root of the genotypic variance by the population mean. Heritability in broad sense was computed by the formula suggested by Johnson et al. (1955) and the genetic advance according to the formula given by Allard (1960).

Results and Discussion

Use of mutations for obtaining early maturing varieties has been a frequent breeding object (Micke, 1979). In the present study, early maturing mutants, K-851-A (0.2% EMS), K-851-B (0.02% SA), K-851-C (20 kR gamma rays), PS-16-A (0.2%EMS), PS-16-B (0.02% SA) and PS-16-C (20 kR gamma rays) were significantly earlier than the parental varieties (Tables 1 and 2). A significant gain in reducing the maturity period by 6 and 9 days was obtained for mutant lines K-851-A and

Table 1 Estimates of mean values ($\bar{x}$) and genetic parameters for days to flowering of the mutants.

Strain number	Treatment	Mean±S.E.	Shift in $\bar{x}$	Genotypic variation ($\delta^2 g$)	Heritability (h^2)	Genetic advance (Gs)
M_4 generation						
K-851	Control	48.20±1.02	0.00	9.01	0.24	3.89
K-851-A	0.2%EMS	44.80±0.70	-3.40	29.15	0.77	12.48
K-851-B	0.02%SA	41.43±0.52	-6.77	18.15	0.81	10.11
K-851-C	20kR	42.90±1.14	-5.30	52.25	0.66	15.53
CD (1%)	gamma ray		5.25			
PS-16	Control	41.80±0.74	0.00	0.41	0.16	0.67
PS-16-A	0.2%EMS	37.56±0.26	-4.24	1.75	0.50	2.47
PS-16-B	0.02%SA	37.53±0.25	-4.27	1.98	0.58	2.83
PS-16-C	20kR	38.16±0.59	-3.64	22.09	0.79	11.01
CD (1%)	gamma ray		1.48			
M_5 generation						
K-851-A	0.2%EMS	44.20±0.40	-4.00	21.29	0.80	10.84
K-851-B	0.02%SA	42.05±0.29	-6.15	18.20	0.88	10.53
K-851-C	20kR	43.00±0.32	-5.20	25.61	0.68	10.97
CD (1%)	gamma rays		2.59			
PS-16-A	0.2%EMS	37.80±0.29	-4.00	9.40	0.75	6.98
PS-16-B	0.02%SA	37.50±0.14	-4.30	3.21	0.46	3.18
PS-16-C	20kR	38.10±0.26	-3.70	21.50	0.96	11.98
CD (1%)	gamma rays		0.97			

Table 2 Estimates of mean values ($\bar{x}$) and genetic parameters for days to maturity of the mutants.

Strain Number	Treatment	Mean±S.E.	Shift in $\bar{x}$	Genotypic variation ($\delta^2 g$)	Heritability (h^2)	Genetic advance (Gs)
M_4 generation						
K-851	Control	68.03±0.52	0.00	7.30	0.53	5.21
K-851-A	0.2%EMS	62.96±0.53	-5.07	7.99	0.54	5.48
K-851-B	0.02%SA	63.06±0.42	-4.97	12.14	0.81	8.27
K-851-C	20kR	63.46±0.44	-4.57	6.41	0.59	5.14
CD (1%)	gamma ray		3.92			
PS-16	Control	70.73±0.85	0.00	1.57	0.38	2.04
PS-16-A	0.2%EMS	61.06±0.52	-9.67	5.85	0.47	4.39
PS-16-B	0.02%SA	61.36±0.29	-9.37	2.23	0.51	2.80
PS-16-C	20kR	62.10±0.65	-8.63	12.28	0.55	6.88
CD (1%)	gamma ray		3.27			
M_5 generation						
K-851-A	0.2%EMS	62.00±0.31	-6.03	8.29	0.59	5.82
K-851-B	0.02%SA	63.00±0.36	-5.03	12.30	0.82	8.38
K-851-C	20kR	63.29±0.40	-4.74	7.25	0.54	5.19
CD (1%)	gamma rays		2.47			
PS-16-A	0.2%EMS	61.17±0.31	-9.66	5.90	0.49	4.48
PS-16-B	0.02%SA	61.21±0.27	-9.52	2.40	0.56	3.04
PS-16-C	20kR	62.00±0.29	-8.73	14.00	0.68	8.09
CD (1%)	gamma rays		1.25			

PS-16-A respectively. A wide range of genetic variability was observed in mutant lines. Since days to maturity is quantitatively inherited and is subject to different degree of non heritable variability and more particularly its genetic components are the most important aspects of this breeding material. This has a close bearing on the response to selection. In the present study, heritability estimates for days to maturity were high. High heritability indicates that the induced variability in mutant lines was fixed by selection. Ibrahim and Sharaan (1974) showed that the increase in heritability is an indication of effective selection. Johnson et al. (1955) suggested that heritability estimates coupled with genetic advance are more helpful than the heritability values alone. This is because, the heritability estimates are subject to genotype-environment interactions (Kaul and Kumar, 1983). Furthermore, genetic advance gives the extent of stability and genetic progress for a particular trait under a suitable selection system. Results on days to maturity are quite encouraging since it possesses sufficiently high values of heritability and genetic advance.

Earlier studies on mutation breeding in crop plants such as soybeans (Papa et al ,1961), wheat (Swaminathan, 1963; Scossolil, 1964; Borojevic, 1969), barley (Gaul, 1967) and rice (Chakrabarti, 1975) brought out a reduction in mean values for plant yield when compared to the control, although Kaul (1977) in *Pisum sativum*, Sharma *et al* (1974) and Reddy (1975) in *Oryza sativa*, Bansal (1972) in barley and Tickoo and Jain (1979), Chaturvedi and Singh (1980) and Wani and Khan (2006) in mungbean found early ripening mutants are competitive with or even superior to their mother varieties with regard to seed production. A mutant strain of *Vigna radiata* obtained in EMS treatments is superior to its mother variety under varying conditions of rainfall due to a favorable

combination of earliness, drought resistance and increased seed production (Prasad, 1976). Gottschalk and Wolff (1983) suggested that the mutant gene may act as a kind of foreign element within the genome, disturbing its genetic balance which results in a reduced vitality or seed production of the plants. The plant yield of mutant lines in the present study was not affected significantly in any direction which could due to occurrence of polygenic mutations with 'plus' and 'minus' effect equally distributed. Jana and Roy (1973) reported an increase in variation without an apparent mean change in quantitative traits in rice. Rubaihayo (1976) obtained high yielding mutants and found significant genetic variability in yield and maturity in soybean plants, grown from seeds irradiated with gamma rays. A negative correlation between days to maturity and yield was reported by Ravi (1982) in *Cajanus cajan* and Vyas and Chauhan (1994) in *Vigna radiata*.

Acknowledgments

We are grateful to the Chairman, Department of Botany, Aligarh Muslim University, Aligarh for providing the research facilities.

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Manuscript received 10 March 2009, accepted 12 June 2009