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INCREASED GENETIC VARIABILITY FOR TOTAL PLANT YIELD IN M_3 GENERATION OF MUNGBEAN

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ABSTRACT

A work was carried out to investigate the yield and yield components in the two varieties of mungbean namely Asha and K-851 in M_3 generation. The total yield per plant, shows that there was a general increase in the mean values for each treatment in both the varieties. The mean value in the treated population significantly varies as compared to the control. The phenotypic and genotypic coefficient of variation, heritability and genetic advance increased in both the varieties after the mutagenic treatments. The increase in the phenotypic coefficient of variation and the genetic parameters was higher with 0.2% EMS treatment in the variety K-851

KEY WORDS : Genetic parameters, mutagens, Mungbean, M_3 generation

Induced mutations have been used to enhance genetic variability, which was utilized not only to increase crop productivity but also for basic studies in various crops. Mutational studies involved in the assessment of different genotypes for selecting appropriate mutagenic doses, determination of effectiveness and efficiency of different mutagenic treatments, breeding behaviour of mutants and utilization of desirable mutants for developing variaties.

Mungbean is a self-pollinated crop, mutation breeding is an important source of creating genetic variability. Hence, in general, induced mutation provided a modern and fruitful tool in crop plants for creating genetic variability (Swaminathan 1969, Gottschalk 1972, Khan 1979)

However, very scanty information exists regarding the yield and its components in mung bean. An attempt has been made to evaluate the yield of the isolated mutants in M3 generation of mungbean in both the varieties viz., Asha and K 851 with Ethylmethane sulphonate, Sodium azide and Hydrazine hydrate.

MATERIALS AND METHODS

Two Indian varieties of mungbean (*Vigna radiata* L. Wilczek) namely; Asha and K-851were used in the present investigation. The varieties are well adapted to agroclimatic conditions of Uttar Pradesh (including Aligarh, the site of this study) and are popular for cultivation in this region.

Variety Asha

This variety was released in 1991 for general cultivation in irrigated areas of Haryana state. The variety is especially suitable for Kharif season and is semi-erect in growth habit. The seeds are medium, smooth and Shining in colour. It matures in 70-75 days. Average yield is 9-11 q/ha.

Variety K-851

The variety K-851 has been developed at Kanpur. It is erect and semi-tall. The seeds are medium bold, smooth and shining green. It matures in 65-70 days (five days earlier than variety Asha). Average yield is 10-12 q/ha.

Mutagens Used

1. Ethylmethane sulphonate (EMS)- $CH_3 SO_2 OC_2H_5$

(i) Manufactured by Koch-light laboratorie Ltd., Coin Brook Bucks, England.

(ii) EMS is a monofunctional alkylating agent, causes depurination, transition and formation of triesters in the backbone of DNA molecule.

2. Sodium azide (SA)-NaN_3

(i) Manufactured by India drugs and Pharmaceutical Ltd. (A Govt. of India undertaking), Hyderabad, India.

(ii) It is used as respiratory inhibitor. During duplication of DNA by base transition mechanism, it causes point mutation.

3. Hydrazine hydrate (HZ)- NH_2-NH_2-H_2O

(i) Manufactured by Sigma Company, Germany.

(ii) It is a base analogue of nucleic acid and thereby causing gene mutation in the DNA molecule.

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M_3 Generation

For raising the M_3 generation of the mutagenic treated population, two treatment of each chemical mutagen for each variety were selected which gave the maximum total plant yield in M_2 generation. The elected treatments were 0.1 and 0.2 per cent of EMS and 0.01 and 0.02 per cent of SA and HZ. For each of these treatments, such ten M_2 progenies were selected which showed significant deviations in mean values in the positive direction from the mean values of control, particularly for the yield and yield components. All the selected M_2 progenies of each treatment together with controls were sown in plant progeny row. Fifty seeds from each selected M_2 plants were sown in the field. The plant showing morphological, chlorophyll, and other variations were discarded from each progeny. Seeds were taken only from the normal looking M_2 plants. Observations were recorded for the quantitative characters on 30 normal looking plants in each progeny and plants were harvested individually at maturity.

Statistical Analysis

While analysis of variance, (ANOVA) as a test of significance was applied to the data according to the Singh and Choudhary (1985), the Heritability (h^2) was on the other hand estimated by the formula suggested by Johnson et al. (1955). The estimate of genetic advance (Gs) with 1% selection intensity were based on the formula derived by Allard (1960) and as modified by Khan (1979)

RESULTS AND DISCUSSION

The most desirable character in plant breeding programme is considered as yield per plant and its yield component. The total yield per plant, show that there was a general increase in the mean value for each treatment in both the varieties. The mean value in the treated population significantly varies as compared to the control.

The phenotypic and genotypic coefficients of variation, heritability (with a very few exceptions) and genetic advance increased in both the varieties after the mutagenic treatments. The increase in the phenotypic coefficient of variation and the genetic parameters was higher with 0.2% EMS treatment in the var. K-851. The variety K-851 was more sensitive than variety Asha.

The vital role of mutagens in inducing both micro and macro mutations in several crops is well established and hence mutation breeding is gaining considerable range of interest. Success in selecting a desirable plant type depends upon the genetic variability in the base population, and mutation breeding offers the unique possibility of creation of new germplasm for crop improvement (Brock, 1977; Konzak,1987). In the present study, a wide range of variablitiy was observed for yield and yield components in both the varities of mungbean in M_3 generation . A glance at the data indicates that the mean values of these characters increased significantly in different mutant lines in comparison to the control. All these characters showed considerable increase in the values of genotypic coefficient of variation, heritability and genetic advance, indicating that these characters can be transmitted to future generations and further improvements of these quantitative characters is possible in subsequent generations. Frey (1969) reported that the mutagen derived variability for quantitative characters in crop plant is heritable and that the response to selection is good .The similar results were also reported earlier by Khan and Siddiqui, (1993,1997): Kumar and Mishra, (2004) and Singh, (2006).

Heritability is of interest to plant breeder primarily, as a measure of the value of selection for particular character and also as an index of transmissibility of a character. The yield and yield components were found to have a high heritability. The heritability estimates for all the quantitative character under study have increased over the control except for a few instances where heritability of the treated population was lower than the control. The decrease in the heritability in some of the treatments indicates that, even though genetic variance has increased with the mutagenic treatment, the ratio of its increase was not at par with the total phenotypic variance which also increased (Table 1).

Genetic advance is indicative of the expected genetic progress for a particular trait under suitable selection procedure (Kaul, 1980) and consequently carriers much significance in self-pollinated crops. The estimated values of genetic advance, in percentage of mean, differed in different mutagenic treatments and also from one variety to another. In general, EMS treatments gave the maximum

Table 1 : Estimates of mean value (X), shift in mean , coefficient of variation, heritability (h^2) and genetic advance (Gs) for total plant yield in M_3 generation

Treatment		Var. Asha				Var. K -851		
		Mean $\pm$ S.E.	Shift in $\bar{X}$	CVp (%)	CVg (%)	h^2(%)	Gs (% of $\bar{X}$)	L.S.D
				Var . Asha				
Control		9.83+0.069	0.00	1.20	0.52	25.55	0.67	
0.1	**% EMS**	12.39 $\pm$ 0.086	+2.56	7.49	4.07	29.66	5.69	5% = 0.10
0.2	**% EMS**	12.43 $\pm$ 0.075	+2.60	8.70	5.57	41.18	9.37	1% = 0.15
0.01	**%SA**	11.93 $\pm$ 0.048	+2.10	4.52	2.12	22.58	2.57	5% = 0.11
0.02	**%SA**	12.44 $\pm$ 0.008	+2.61	3.25	2.01	39.06	3.31	1% = 0.17
0.01	**%HZ**	12.03 $\pm$ 0.003	+2.20	4.38	2.34	29.19	3.30	5% = 0.03
0.02	**%HZ**	12.48 $\pm$ 0.004	+2.65	6.89	2.09	9.28	1.62	1% = 0.05
				Var . K-851				
Control		10.15 $\pm$ 0.010	0.00	2.05	1.10	30.70	1.56	
0.1	**% EMS**	14.72 $\pm$ 0.009	+4.57	9.67	6.08	39.43	9.94	5% = 0.03
0.2	**% EMS**	14.93 $\pm$ 0.004	+4.78	10.47	7.16	46.63	12.67	1% = 0.04
0.01	**%SA**	14.05 $\pm$ 0.004	+3.90	5.64	2.67	22.38	3.25	5% = 0.06
0.02	**%SA**	13.81 $\pm$ 0.009	+3.66	7.15	3.10	18.72	3.37	1% = 0.09
0.01	**%HZ**	14.12 $\pm$ 0.002	+3.97	5.41	2.86	27.85	3.84	5% = 0.09
0.02	**%HZ**	14.47 $\pm$ 0.029	+4.32	8.26	4.59	30.87	6.52	1% = 0.13

CVp – Phenotypic coefficient of variation

CVg – Genotypic coefficient of variation values of genetic advance as compared to the other two mutagens. The above yield and yield components possessing a high heritability along with a high genetic advance. The character possessing a high heritability along with a high genetic advance are more responsive to the effective selection and improvement. Results about yield and yield components are quite encouraging since they possess sufficiently high value of heritability and genetic advance. According to Panse (1957) if heritability is mainly due to the non-additive genetic effects (dominance and epistasis), the genetic gain would be low, while in other cases, where the heritability is chiefly due to the additive gene effects, a high genetic advance may be expected.

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