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Increased Genetic Variability for Total Plant Yield and Seeds per Pod in M_2 Generation of Butter Bean (*Phaseolus lunatus* L) Variety KKL-1

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A B S T R A C T

Study was carried out to investigation the yield and number of seed per pod of butter bean variety of KKL-1 in M_2 generation. The total yield per plant shows that there was a general increase in the mean value for each treatment in the variety. The mean value in a treated population significantly varies as compared in the control. The phenotypic and genotypic co- efficient of variation, heritability and genetic advance increased the varieties after the mutagenic treatment, increase in the phenotypic co-efficient of variation and the genetic parameter was high with 10 kR gamma rays treatment in the variety of KKL-1 Butter bean.

Introduction

Induced mutation plays a significant role in the crop improvement of horticultural crops. It is an important tool for induction of variation in quantitative and qualitative characters. It can be a supplement to conventional breeding methods when it is desired to improve one or two characters in a well adapted variety. Much progress has been made in generating superior genotype with favourable attributes through induced mutations. It is much more useful in crop where cross incompatibility mechanisms exist. Creation of variability in highly self pollinated crops like peas and beans is very difficult by heterosis breeding due to high crossing barrier and poor seed setting.

Butter beans (*Phaselous lunatus L*) belong to the family Leguminaceae. KKL-1 butter bean is a selection from a local type collected of Vilpatti. It is a pole type and bean growing up to a height of 2.42 m. The pods are cluster

11.6 cm long and beans are 5 to 6 numbers per pod. The pods are green when immature, turning creamy yellow with brownish purple streaks on the surface at maturity. The seeds are bold, globular snow white in color with excellent cooking quality. The variety is suited for hilly regions of Tamil Nadu with attitude longest from 1200 m to 2200 m above MSL. The crop will be ready for first harvest from 100 days after sowing and the harvest continues up to 140 days with a potential yield of 3.47 tonnes of mature pods per hectare in three or four pickings. The present investigation is to study the effect of gamma irradiation in KKL-1 in evolving a mutant with some specific for desirable traits.

Materials and Methods

The present investigation was carried out during 2012-13 on the "Studies on induced mutation in butter bean (*Phaseolus lunatus L*) var. KKL-1 through gamma rays at the Department of Vegetable crop, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore.

Field trial was conducted in the poly house and open field at Horticultural Research Station, Kodaikanal, which is geographically situated between 10°24' N latitude and 77°48' E longitude at an altitude of 2225 m above Mean Sea Level. The mean minimum and maximum temperature during the study period between 2.5°C and 30°C respectively and the relative humidity was 40 to 100 per cent. The soil of the experimental field is loamy silt with a pH of about 5.85.

Characters	KKL-1 Butter bean
Pedigree	Selection from a local type
Organisation of release	HRS, TNAU, Kodaikanal
Habit	Pole type (2.42 m)
Maturity	140 days
Pod yield	3.47 tonnes ha^{-1}

Physical mutagen *viz*. gamma rays (ionizing radiation) the gamma treatments were given by using the 1000 curie Cobalt-60 Gamma cell 900, located at the Centre for Plant Breeding and Genetics (CPBG), Tamil Nadu Agricultural University, Coimbatore, where cobalt- 60 serves as source of gamma rays.

Number of seeds per pod

Number of seeds was counted from each five pods selected randomly from the plant.

Seed yield per plant (g)

The seed yield from all the selected plants was recorded at each harvest. Total and mean was obtained and expressed as grams per plant.

Results and Discussion

The most desirable character in plant breeding program is considered as yield per plant and numbers of pods per plant its yield component. The total yield per plant, show that there was a general increase in the mean value for the treatment in the variety. The mean value in the treated population significantly varies as compared to the other treatment (Tables 1 and 2).

Yield attributing characters

Seed yield per plant the plants exposed 10 kR and 5 kR gamma rays recorded significant increase in seed yield per plant in KKL-1 butter bean, the seed yield per plant ranged from 33.12 g at 15 kR to 36.18 g 10 kR, in the control population the seed yield 34.50 g. Whereas, the gamma rays doses of 10 kR had a slight stimulatory effect. Number of seed per pod the number of seed per pod was higher in plants treated with 10 kR (7.06) than control (5.66) and thereafter the number of seed per pod was reduced and reached a

minimum of 5.04 at 15 kR. The gamma rays doses at 10 kR had a stimulatory effect over the control in increasing the number of seed per pod.

The present study has indicated that in M_2 generation, plant height showed decreasing trend with increase doses of gamma rays. The number of seeds per pod, seed yield showed positive change at lower doses and negative change at higher doses. The number of seeds pod at 5 kR and control were on par and the number of pod per plant at 10 kR, 5 kR and 15 kR was on part. The increase in pod yield in M_2 generation in mean values in the M_2 generation indicates the elimination of deleterious genes. Such shifting of means in yield has been reported by Gregory (1956), Rawlings *et al.,* (1958) and Gaul (1961) the increase in seed yield from 34.50 g the control to 36.18 g in the mutants (10 kR) exhibited the contributing effect of small mutation attributes which resulted in yield increase this is evident from the fact that positive contribution by the beneficial mutagen observed in the traits BB10M132, BB10M149, BB10M122, harvested in yield increase beneficial mutations at lower doses of gamma rays in a common occurrences as this may induce point mutations.

Effect of gamma rays on PCV and GCV

Micro mutational events with the least deleterious effects were considered to be the most reliable and effective mutation in providing variability for quantitative characters and such approach has been successfully demonstrated by Gregory (1960) in peanut and Rawlings *et al.,* (1958) in soybean. Aastvent (1968) and Scossiroli (1966) suggested that an estimation of the extent of induced genetic variability for quantitative traits in M_2 would provide valuable information for designing a selection programme.

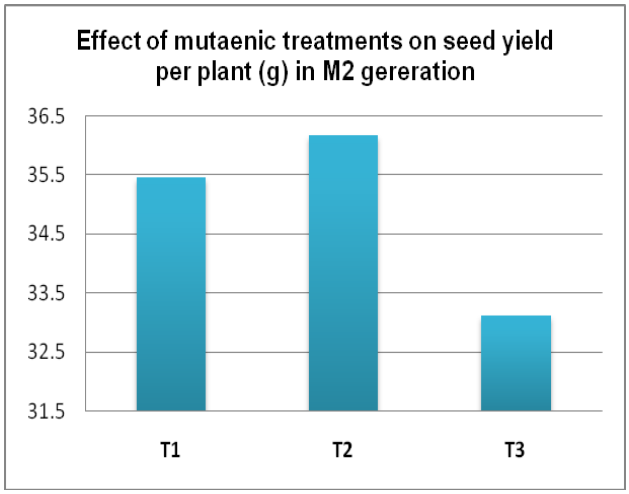
Information on genotypic variance would helps to measure the range of genetic diversity among the progenitor available for characters and provides a means to compare the genetic variability in parameter has been used to compare the variability arising out of induced mutagenesis. The present investigations in butter bean revealed that the genotypic variance was higher in the treated populations, offering scope for effective selection. In the present study higher genotypic coefficient of variation for number of pods per plant, seed yield per plant was observed that mean of all the three treatment. These characters indicated that the high variability which can be exploited for further improvement through selection. These results are in conformity with the findings of Choulwar and Borikar (1985), Murugan and Subramanian (1993) in cowpea and Khan (1981) in mung bean.

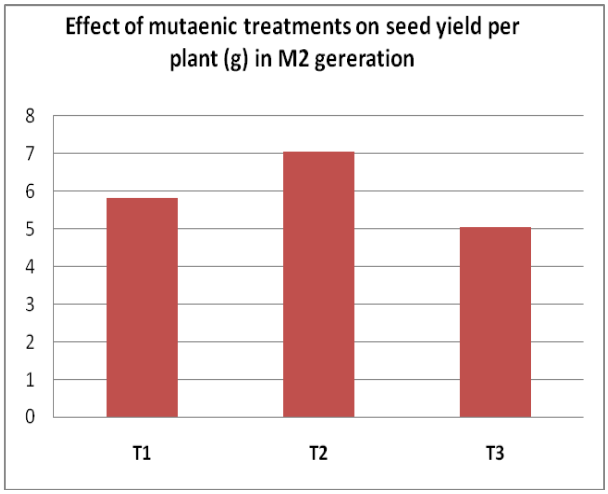
Table.1 Effect of mutagenic treatments on mean, measures of dispersion and variability parameters of seed yield (g)/ plant in M_2 generation

S.No	Treatment	Minimum	Maximum	Mean	Control mean	PCV (%)	GCV (%)	h^2 (%)	GA	GA as per cent of mean
1.	5 kR	34.1	36.7	35.45	34.50	1.52	1.47	94.0	0.70	1.99
2.	**10kR**	**35.5**	**36.54**	**36.18**	**34.50**	**3.36**	**3.33**	**98.4**	**0.74**	**12.38**
3.	15 kR	30.1	33.12	33.12	34.50	0.59	0.46	61.6	0.46	1.28

Table.2 Effect of mutagenic treatments on mean, measures of dispersion and variability parameters of Number of seeds/ pod in M_2 generation

S.No	Treatment	Minimum	Maximum	Mean	Control mean	PCV (%)	GCV (%)	h^2 (%)	GA	GA as per cent of mean
1.	5 kR	5.00	7.00	5.82	5.66	11.75	7.48	26.4	0.46	9.08
2.	**10kR**	**6.00**	**8.00**	**7.06**	**5.66**	**16.34**	**12.41**	**40.6**	**0.61**	**10.43**
3.	15 kR	4.00	7.00	5.04	5.66	10.19	10.01	35.0	0.36	0.86





Effect of gamma rays on heritability and GA as percentage of mean

Though the genotypic coefficient of variation reveals extent of variability present in the genotypes for the various characters, it does not indicate the variation to be heritable. The heritability estimates help to assess the heritable portion of variation and the selection would be more effective, if the estimates of heritability are high. High heritability indicates genetic nature of induced mutations (Scossiroli, 1966). Estimation of GA as percentage of mean would show the extent of

genetic gain that could be expected when the population is subjected to selection (Burton, 1952 and Johnson and Webber 1965). As heritability in broad sense includes additive and epistatic gene effects, it could be reliable only if the heritability is accompanied by high GA as percentage of mean (Ramanujam and Thirumalachar, 1967).

Among the characters evaluated in the present investigation, high heritability and high GA as percentage of mean were obtained for number of flowers per cluster, pod girth, seed yield, number of seeds per pods, 100 seed weight and individual pod weight. These characters having high heritability and GA as per cent of mean showed additive gene effect and may be selected for further generation. These results are in conformity with the findings of Choulwar and Borikar (1986), Thirugnanakumar (1986) and Rangaswamy (1989) in cowpea and Lokesha and Veeresh (1993) in rice bean.

Among the characters evaluated in the present investigation, high PCV, High GCV, high heritability and high GA as parentage of mean were obtained for plant, number of pods number of seeds yield per pods. These characters are more amenable for selection while forwarding to M_3 generation.

The phenotypic and genotypic coefficient of variation, heritability (with a very few exceptions) and genetic advance increased in the varieties after the mutagenic treatments. The increase in the phenotypic coefficient of variation and the genetic parameters was higher with 10 kR Gamma rays Treatment in the var. KKL-1 butter bean 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)

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