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Genetic variability study in advanced mutant lines of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.]

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ABSTRACT

Advanced cluster bean mutant lines developed by treating seeds of Pusa Navbahar variety with gamma radiation were evaluated in randomised complete block design with two replications to study the genetic variability. The analysis of variance revealed highly significant differences among the mutant lines of cluster bean for all the characters studied. The GCV and PCV values were high (>20 %) for number of vegetable pods per plant, pod yield per plant, pod yield per plot, pod weight, dry pod yield per plant, seed yield per plant and seed yield per plot indicating the existence of broad genetic base, which would be amenable for further crop improvement. High heritability (>60 %) coupled with high genetic advance over mean (>20 %) were observed for characters *viz.,* plant height, number of vegetable pods per plant, number of pods per cluster, pod yield per plant and seed yield per plant which indicated predominance of additive gene action for these traits and hence direct selection would be more effective in improving these traits.

Key words: *Cluster bean, Gamma radiation, Genetic variability, Mutants.*

Introduction

Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub] is an important under exploited leguminous vegetable crop belongs to the family Fabaceae having diploid chromosome number of 2n=14. It is commonly known as guar, chavlikayi, guari, khutti etc., cultivated mainly as rain fed crop in arid and semi-arid regions of India during *kharif* season as vegetable, forage and green manure. Guar is a drought tolerant, well adopted to poor and erratic rains, requires low inputs and less care. The guar gum extracted from the beans is used as natural polysaccharide, viscosity builder in fracking process of petroleum extraction, paper, mining, textile, cosmetics, pharmaceuticals and food industries as thickener and stabilizer (Punia *et al.*, 2009).

The present germplasm of cluster bean lacks the

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needed natural variability for developing superior high yielding lines. Moreover, the creation of genetic variability in this crop through recombination of genes by hybridization is very difficult and cumbersome owing to small, delicate flower structures (Mahla and Sharma, 2022) resulting in low percentage of crossed seed setting in the manually hybridized buds. Due to these reasons, not much desirable and usable genetic variability has been generated through conventional breeding approaches. Keeping in view the above limitations, mutation breeding is a powerful tool for enriching variation in a crop like cluster bean where exploitable and useful genetic variability is very meagre due to its self-pollinating nature.

The phenotypic expression of the plant is mainly controlled by genetic makeup of the plant and environment under which the crop is grown. Therefore, it becomes necessary to partition the observed phenotypic variability into its heritable and non-heritable components with suitable parameters such as phenotypic and genotypic coefficient of variations. Therefore, the present investigation was undertaken to study the extent of genetic variability in advanced mutant lines of cluster bean.

Materials and Methods

The experimental material comprising thirty nine mutants of cluster bean which were developed by treating the seeds of Pusa Navbahar variety with gamma radiation at Department of Biotechnology, College of Horticulture, Bengaluru and were advanced to M_5 generation. Thirty nine mutants of M_6 generation and a check Pusa Navbahar were evaluated during summer 2021-22 at College of Horticulture, Mudigere to study the genetic variability and character association among yield and yield parameters.

For recording the various observations, in each experimental genotype block five plants were selected randomly by avoiding border plants and were tagged. After the picking of tender green pods for vegetable purpose at weekly interval vegetable pod yield parameters were recorded from vegetable purpose block. Similarly, five selected plants were tagged and all the pods were left for seed parameters in seed purpose block. The fully matured and dry pods are harvested for recording seed yield and other parameters. Throughout the growth period, recommended cultivation practices and protection measures were followed.

The genetic variability parameters like *per se* performance, Genotypic Coefficient of Variation (GCV) and Phenotypic Coefficient of Variation (PCV) were estimated according to Burton and Devane (1953), heritability, genetic advance (GA) and genetic advance as percentage of mean by Johnson *et al*. (1955).

Results and Discussion

The results indicated that there is highly significant variation among the genotypes for almost all the characters under study. These results were in accordance with the findings of Goudar *et al.* (2017) and Rai *et al*. (2012) which clearly indicates that wide range of variability exists for yield and yield components among the lines studied.

The estimates of phenotypic coefficients of variation (PCV), genotypic coefficients of variation (GCV), heritability and genetic advance (expressed as percentage of mean) for all studied traits are also given in Table 1. High GCV and PCV values were observed for number of vegetable pods per plant (23.59 and 24.49%), pod weight (g) (24.15 and 24.75%), pod yield (g/plant) (34.09 and 34.61%), dry pod yield (g/plant) (27.55 and 28.51%) and seed yield (g/plant) (27.57 and 28.51%). This indicated that the characters showing higher magnitude of coefficient of variation offer better opportunity for improvement through direct selection, which was also confirmed by Rai *et al.* (2012) and Deepashree *et al*. (2021).

Moderate GCV and PCV was found in plant height (14.52 and 15.43%), number of pod clusters per plant (10.39 and 12.20%), number of pods per cluster (17.61 & 18.77%), number of seeds per pod (12.59 and 14.31%), pod length (16.06 and 17.40%) and pod breadth (10.81 and 12.77%) indicated limited variability offering scope for improvement of the secharacters. Similar results were also reported by Saini *et al.* (2010), Girish *et al*. (2013) and Rai *et al*. (2012).

Low PCV and GCV were found in days taken for first flowering (3.52 and 5.87%) indicates environment is playing a significant role in expression of this character and selection will be ineffective. These results are in accordance with the findings of Deepashree *et al*. (2021), Rai *et al.* (2012) and Patil (2014).

High heritability (>60%) coupled with high genetic advance asper cent of mean(>20%) was ob-

Table 1. Estimate of genetic parameters for growth and yield attributes in advanced mutant lines of cluster bean

Sl. No.	Characters	Mean	Range	GV	PV	GCV	PCV (%)	h2(%) (%)	GA	GAM (%)
1	Plantheight(cm)	74.17	58.45-99.15	115.94	130.87	14.52	15.43	88.59	20.88	28.15
2	Days to first flowering	32.98	29.20-36.10	1.35	3.75	3.52	5.87	36.05	1.44	4.35
3	Number of pod clusters per plant	14.27	10.7-17.9	2.19	3.03	10.39	12.20	72.41	2.51	18.20
4	Number of pods per cluster	8.56	5.69-11.49	2.27	2.58	17.61	18.77	87.97	2.91	34.02
5	Number of vegetable pods per plant	122.95	72.8-194.01	840.98	906.83	23.59	24.49	92.74	57.53	46.79
6	Pod length (cm)	8.44	5.62-11.14	1.84	2.16	16.06	17.40	85.17	2.58	30.53
7	Pod breadth (mm)	7.02	5.66-8.62	0.58	0.81	10.81	12.77	71.59	1.32	18.84
8	Pod weight (g)	1.39	0.75-2.16	0.11	0.12	24.15	24.75	95.24	0.68	48.55
9	Pod yieldperplant (g)	173.25	78.76-314.1	3487.42	3613.40	34.09	34.61	96.51	119.51	68.98
10	Dry pod yield per plant (g)	86.45	43.53-142.95	567.21	607.66	27.55	28.51	93.34	47.4	54.83
11	Number of seeds per pod	8.21	5.87-10.01	1.07	1.38	12.59	14.31	77.36	1.87	22.81
12	Seed yield per plant (g)	13.83	6.96-22.82	14.55	15.55	27.57	28.51	93.55	7.51	54.94

served for most of the studied traits. Similar results were observed by Malaghan *et al*. (2013); Prakash *et al*. (2008); Hanchinamani (2004) and Goudar *et al*. (2017). This indicates that heritability could be mainly due to additive gene effect and selection may be more effective.

High heritability (>60%) coupled with moderate genetic advance asper cent of mean (10-20%) was observed for number of pod clusters per plant and pod breadth indicating the prevalence of non-additive components and there can be little response to selection and these traits can be exploited through heterosis breeding. These results are in accordance with the report of Deepashree *et al*. (2021) and Rai *et al.* (2012).

Moderate heritability (30-60%) with low genetic advance per cent of mean (<10%) was observed for days taken for first flowering which are similar to the results obtained by Hanchinamani (2004). These findings elucidate prevalence of higher influence of environment on this trait therefore, selection for such character is not rewarding.

Evaluation of advanced mutant lines of cluster bean revealed that wide range of variability was observed for yield characters like number of vegetable pods per plant, pod weight, pod yield per plant and dry pod yield per plant. Therefore, suchmutant lines having high variability for these traits can be used for future crop improvement programme. Therefore, by using mutants of M_6 generation, higher level of genetic improvement in cluster bean can be achieved for these traits through simple selection.

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Conflict of interest

The authors have declared that no conflict of interest exists.

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