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GENETIC VARIABILITY STUDIES IN CLUSTER BEAN [*CYAMOPSIS TETRAGONOLOBA* (L.) TAUB]

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Abstract

A field experiment was conducted at Vegetables block, College of Horticulture, Anantharajupeta, Dr. Y. S. R. Horticultural University, Andhra Pradesh during *kharif* 2018 to analyze the variability and heritability in 45 cluster bean genotypes for growth, pod yield and yield parameters. Highly significant differences were observed among genotypes. High range of variability was observed for characters *viz.,* number of branches per plant at maturity, number of clusters per plant, pod length, pod yield per plant, 100 seed weight and protein content. High heritability coupled with high genetic advance over mean was observed for characters *viz.,* number of branches per plant at maturity, number of pods per cluster, number of clusters per plant, pod length, pod yield per plant, vegetable pod yield per plot, 100 seed weight and protein content in seeds. The results of present investigation suggested that selection based on number of branches per plant at maturity, number of clusters per plant, pod length, pod yield per plant, 100 seed weight and protein content might bring improvement in vegetable pod yield of cluster bean and its growth and yield components characters.

Key words : Cluster bean, genetic variability.

Introduction

A large number of unexploited leguminous species have a great potential for contributing to nutritive food, feed and forage needs in the tropical countries, where almost half of the world's under and malnourished population lives (Singh and Paroda, 1983). In this regard, Asia-Pacific region possesses a rich diversity of several useful under-exploited vegetables, which are resilient, adaptive and tolerant to adverse conditions. They can be grown on marginal lands and with poor crop husbandry. Many of them are nutritionally superior to traditional vegetables. Among such under-exploited legume vegetables, cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] also known as guar, goru chikkudu., is one of most important and potential vegetables cum industrial crops grown for its tender vegetable pods and seed endospermic gum (30- 35%).

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Cluster bean has been under cultivation in small area as a vegetable, its potentiality is yet to be exploited. Therefore, there is need for identification or development of cluster bean genotypes suited for vegetable production.

The knowledge on genetic variability in the available germplasm is a prerequisite for effective selection of superior genotypes. Therefore, in the present investigation, an attempt was made to estimate the extent of variability, heritability and genetic advance in 45 accessions of cluster bean germplasm.

Materials and Methods

A field experiment was conducted at Vegetables block, College of Horticulture, Anantharajupeta, Dr. Y. S. R. Horticultural University, Andhra Pradesh during *kharif* 2018. Cluster bean germplasm comprising of 45 genotypes table 1 (including check variety Pusa Navbahar and MDU-1) were collected from different geographical

Table 1: Source and place of collection of cluster bean genotypes used in the study.

Source	Number of Genotypes	Genotypes
ARS, Durgapur, Rajasthan	18	GP-1,GP-2,GP-3,GP-5,GP-6,GP-7,GP-8,GP-10,GP-11, GP-12,GP-13,GP-14,GP-15,GP-16,GP-17,GP-18,GP-19, GP-20.
NBPGR, Jodhpur, Rajasthan	25	IC-113272,IC-113278,IC-113281,IC-113308,IC-113377,IC-113390,IC-113393,IC-113394,IC-113396,IC-113499,IC-113506,IC-113523,IC-113568,IC-116569,IC-116608,IC-116619, IC-116626,IC-116652,IC-116660,IC-116705, IC-116779,IC-116825,IC-116925,IC-116930, IC-116932.
AAU, Anand, Gujarat	1	PUSA NAVBAHAR
TNAU,Coimbatore, Tamilnadu	1	MDU-1

Table 2: Analysis of variance for different traits in forty five cluster bean genotypes.

Sl. No.	Character	Mean sum of squares		
		Source of variation		
		Replications df = 2	Treatments df = 44	Error df = 88
1	Plant height at 30 days (cm)	29.38	90.98**	23.36
2	Plant height at harvest (cm)	497.46	390.64**	179.66
3	Days to first flowering	14.83	51.75**	7.17
4	Days to 50% flowering	18.61	49.29**	8.60
5	Pod thickness (mm)	0.03	0.40**	0.03
6	Pod length (cm)	3.08	4.61**	0.27
7	Pod width (mm)	1.55	1.03*	0.64
8	Number of pods per plant	740.80	10297.36**	4571.91
9	Number of pods per cluster	0.00	16.27**	0.08
10	No. of clusters per plant	0.01	9.24**	0.10
11	Number of branches per plant at maturity	1.59	42.55**	0.84
12	No. of seeds per pod	0.02	1.11**	0.02
13	100 seed wt (g)	0.56	1.79**	0.19
14	Days to pod maturity	0.01	8.03**	0.12
15	Protein content (%)	0.02	27.13**	0.00
16	Gum Content (%)	1.78	3.55**	1.29
17	Pod yield per plant (g)	2054.16	7771.30**	1356.55
18	Pod Yield (t/ha)	11.27	42.64**	7.45

*Significant at 5 per cent level; ** Significant at 1 per cent level

regions were evaluated in a randomized block design (RBD) with three replications. Each treatment was raised in 10 m long beds with a spacing of 45 cm between rows and 30 cm between plants. Optimum cultural and management practices as per university recommendation were followed for raising the crop. Observations were recorded on randomly selected five plants in each experimental plot. The observations on plant height at 30 days (cm), plant height at harvest (cm), number of branches per plant, days to first flowering, days to 50% flowering, days to pod maturity, pod length (cm), pod thickness (mm), pod width (mm), number of pods per cluster, number of clusters per plant, number of pods per plant, number of seeds per pod, pod yield per plant (g), pod yield (t/ha) 100 seed weight, protein content (%) and gum content(%). The mean data was subjected to statistical analysis for estimating variability, phenotypic and genotypic coefficient of variation using formula suggested by Singh and Chaudhary (1985), heritability (h^2BS) by Allard (1960) and genetic advance over mean was predicted by formula given by Johnson *et al.,* (1955).

Results and Discussion

The analysis of variance revealed that genotypes under study differed significantly for all the characters (Table 2). The data on general mean, range, the phenotypic (PV) and genotypic (GV) variance, phenotypic (PCV) and genotypic (GCV) coefficients of variation, broad sense heritability (h2), genetic advance (GA) and genetic advance over mean (GAM) are presented in Table 3.

Table 3: Estimates of variability and genetic parameters for yield and its attributes in forty five cluster bean genotypes.

Sl. No.	Character	General Mean	Range		Variance		Coefficient of Variation		Heritability in broad sense (h^2) (%)	Genetic advance (GA)	Genetic advance asper cent of mean (5%)
			Minimum	Maximum	Genotypic	Phenotypic	Genotypic (%)	Phenotypic (%)			
1	Plant height at 30 days	44.21	33.07	55.20	22.54	45.90	10.74	15.33	49.10	6.85	15.50
2	Plant height at harvest	122.91	95.47	146.26	70.33	249.98	6.82	12.86	28.13	9.16	7.46
3	Days to first flowering	24.79	18.67	32.67	14.86	22.03	15.55	18.94	67.44	6.52	26.31
4	Days to 50% flowering	27.18	21.14	35.48	13.56	22.16	13.55	17.32	61.19	5.93	21.83
5	Pod thickness (mm)	4.54	3.47	5.68	0.13	0.15	7.78	8.58	82.20	0.66	14.52
6	Pod length (cm)	6.55	5.82	13.10	1.45	1.72	18.37	19.98	84.50	2.28	34.79
7	Pod width (mm)	7.52	6.85	9.78	0.13	0.77	4.83	11.69	17.10	0.31	4.12
8	Number of pods per plant	233.25	85.32	364.67	1908.48	6480.39	18.73	34.51	29.50	48.84	20.94
9	Number of pods per cluster	13.00	9.20	16.77	5.40	5.48	17.88	18.01	98.50	4.75	36.55
10	No of clusters per plant	8.37	6.29	11.52	3.05	3.15	20.85	21.19	96.76	3.54	42.24
11	Number of branches per plant at maturity	7.81	1.07	13.07	13.90	14.75	47.75	49.17	94.28	7.46	95.50
12	No of seeds per pod	8.73	6.97	10.80	0.36	0.38	6.90	7.07	95.15	1.21	13.86
13	100 seed wt	4.07	3.35	8.47	0.53	0.73	17.94	20.92	73.56	1.29	31.70
14	Days to pod maturity	11.17	8.25	13.56	2.64	2.75	14.55	14.86	95.78	3.28	29.32
15	Protein content	27.30	22.15	32.21	9.04	9.05	11.01	11.02	98.25	6.19	22.68
16	Gum Content	22.84	21.19	25.32	0.75	2.04	3.80	6.26	36.86	1.09	4.76
17	Pod yield per plant(g)	332.99	245.86	479.07	2138.25	3494.80	13.89	17.75	61.18	74.51	22.38
18	Pod yield(t/ha)	24.67	18.21	35.49	11.73	19.18	13.89	17.75	61.18	5.52	22.37

Information on the relative amount of variation can be obtained by correlating coefficients of phenotypic and genotypic variation of every character investigated. It was observed that phenotypic variance was higher than genotypic variance for all the characters studied (Table 2). Phenotypic coefficient of variation ranged from 6.26 (gum content) to 49.17 (number of branches per plant at maturity) and genotypic coefficient of variation ranged from3.80 (gum content) to 47.75 (number of branches per plant at maturity). The estimates of heritability ranged from 17.1 % (pod width) to 98.5 % (number of pods per plant). Genetic advance expressed as percentage over mean ranged from 0.31% (pod width) to 74.51% (pod yield per plant). Moderate PCV and low GCV were observed for plant height at 30 days, plant height at harvest, pod length, 100 seed weight and protein content which indicated presence of moderate amount of variability for these traits. Low GCV and PCV were observed for number of seeds per pod.

High heritability accompanied with high genetic advance indicates the prevalence of additive gene effects and hence, selection would be effective for such traits. The high estimates of heritability coupled with high values of genetic advance over mean (GAM) were observed for characters *viz.*, number of branches per plant at maturity, number of pods per cluster, number of clusters per plant, pod length, pod yield per plant, vegetable pod yield per plot, 100 seed weight and protein content in seeds. High heritability coupled with moderate to low values of GAM were observed for pod thickness, indicated the prevalence of non additive components and there can be little response to selection and these traits can be exploited through heterosis breeding.

Moderate heritability coupled with moderate genetic advance as per cent of mean was observed for the traits like

plant height at 30 days, and number of clusters per plant. Moderate to low heritability coupled with high GA indicates the importance of additive gene effects. Low to moderate heritability with high GAM was obtained for gum content. This indicates the importance of additive gene effects for these traits and there can be better response to selection. The low difference in the extent of PCV and GCV indicates the low influence of environment on expression of above traits. High heritability with moderate genetic advance as per cent of mean is observed for pod thickness and number of seeds per pod. This indicates the influence of non additive gene action and considerable influence of environment on the expression of these traits. Similar findings were also reported by Hanchinamani (2004), Anandhi and Oommen (2007), Prakash *et al.* (2008), Rai *et al.,* (2012) and Girish *et al.,* (2013) in cluster bean.

The heritability portion of variation was obtained by calculating the heritability estimates, which has been found to be satisfactory tools for selection based on phenotypic performance. The estimation of heritability is important in determining the effectiveness of selection of a character provided it is considered in conjunction with the genetic advance (Johnson *et al.,* 1955). Heritability is influenced by biometrical method, generation of hybrid, sample size or experimental material and environment. In the present study, high heritability associated with high genetic advance table 3 for different characters were indicative of dominance and epistatic effects.

Conclusion

Prevalence of high degree of additive components of genetic variance, high estimates of heritability coupled with high GAM and presence of high GCV and PCV for the characters, number of branches per plant at maturity, number of pods per cluster, number of clusters per plant, pod length, pod yield per plant, vegetable pod yield per plot, 100 seed weight and protein content in seeds indicated additive gene action hence, higher degree of genetic improvement for these traits can be achieved through direct selection using the existing germplasm stock.

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