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Variability, heritability and genetic advance in cluster bean [*Cyamopsis tetragonoloba* (L.) Taub]

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ABSTRACT : Fifty genotypes of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub] were evaluated to estimate variability, broad sense heritability and genetic advance for pod yield and related attributes, during *Kharif* 2008. High estimates of GCV and PCV were recorded for number of branches per plant, number of clusters per plant, number of pods per cluster, fresh pod yield, dry pod yield, 100 seed weight and gum content. High heritability coupled with high genetic advance was observed for plant height, number of branches per plant, number of clusters per plant, number of pods per cluster, pod length, fresh pod yield per plant, dry pod yield per plant, seed yield per plant, 100 seed weight, days taken to maturity, crude protein and gum content. High heritability with low genetic advance was observed for the trait, days taken to maturity. The results of the present investigation suggests that plant height, number of branches per plant, number of clusters per plant, number of pods per cluster, pod length, fresh pod yield per plant, dry pod yield per plant, seed yield per plant, 100 seed weight, days taken to maturity, crude protein and gum content had predominance of additive gene action and hence selection is more effective.

Key Words : Cluster bean, Variability, GCV, PCV, Heritability, Genetic advance

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Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub] also known as guar, is a drought tolerant, annual legume of dry regions. It is a multipurpose crop grown for green vegetable pods, grains, forage and green manure. In South India, it is raised in kitchen garden and marginal farmers grow cluster bean for vegetable purpose near the cities and towns. Among the dry land crops, cluster bean occupies an important place in the national economy because of its industrial importance mainly due to the presence of gum in its endosperm.

The most important property of the guar is its ability to hydrate rapidly in cold water to attain a very high viscosity at relatively low concentrations. Keeping in view its importance as a vegetable, as grain for guar gum extraction and its adaptability to drought conditions, there is a need for its improvement for yield and various other traits suited to specific agro ecological conditions. Cluster bean has wide scope for improvement through systematic and planned breeding programme. The yield potential of the crop is mainly determined by the genetic makeup, but is highly influenced by the environmental factors. Therefore, an attempt was made to study the mean performance of quantitative and qualitative traits, variance, heritability and genetic advance of different characters. Studies on genetic variability for yield and yield component characters are a pre requisite. Since, phenotypic variability is highly influenced by the environment; it does not give a real picture of the potential genotypic variability. Hence, knowledge about heritability and genetic advance on yield and yield contributing characters are necessary for the crop improvement through selection.

RESEARCH PROCEDURE

Fifty cluster bean genotypes were collected from NBPGR, New Delhi and were evaluated in a Randomized Block Design, with three replications in the Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute,

Karaikal, U.T. of Puducherry during *Kharif* 2008. Each plot consisted of 20 plants spaced at 45 cm between row and 15 cm between plants in a row. The details of cluster bean accessions used in this study are given in Table A. A total of five plants under each replication was selected at random and tagged for recording observations. Standard horticultural practices and plant protection measures were followed uniformly. The observations on plant height (cm), number of branches per plant, days taken to first flowering, number of clusters per plant, number of pods per cluster, pod length (cm), pod yield per plant (g), seed yield per plant (g), number of seeds per pod, 100 seed weight (g), days to maturity, harvest index (%), were recorded. The mean data were subjected to statistical analysis for estimating variability, phenotypic and genotypic co-efficient of variation using formula suggested by Burton (1952), heritability (h^2) according to Lush (1940) and genetic advance over mean was predicted by using the formula suggested by Johnson *et al*. (1955).

RESEARCH ANALYSIS AND REASONING

The analysis of variance showed significant difference among the genotypes for all the 16 characters studied (Table 1). The general mean, range, phenotypic and genotypic variance is presented in Table 2. Information on the relative amount of variation can be obtained by correlating co-efficients 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.

Relatively high estimates of GCV and high estimates of PCV was recorded for number of branches per plant, number of clusters per plant, number of pods per cluster, fresh pod yield, dry pod yield, 100 seed weight and gum content. The phenotypic co-efficient of variation was in general higher than the genotypic co-efficient of variation indicating the influence of environment upon the recorded characters. This is in accordance with the findings of Arora *et al*. (2005), Singh *et al*. (2003) for number of branches per plant, number of clusters per plant and pod yield per plant, Babu and Suresh (2007) in peas for number of pods per cluster, Yadav (2007) in soybean, Kumari and Balasubramanian (1993) in cow pea for 100 seed weight.

Phenotypic co-efficient of variation ranged from 4.77 (days taken to maturity) to 38.66 (number of pods per cluster).

Table A : Details of cluster bean accessions used in the study

Genotypes designation used in the text and tables	Treatments	Name of the accessions	Genotypes designation used in the text and tables	Treatments	Name of the accessions
CT 1	T_1	IC-311392	CT 26	T_{26}	IC- 415137
CT 2	T_2	IC-311402	CT 27	T_{27}	IC- 415142
CT 3	T_3	IC-311421	CT 28	T_{28}	IC- 415145
CT 4	T_4	IC-311443	CT 29	T_{29}	IC- 415153
CT 5	T_5	IC-329036	CT 30	T_{30}	IC- 415154
CT 6	T_6	IC-329038	CT 31	T_{31}	IC- 415156
CT 7	T_7	IC-329062	CT 32	T_{32}	IC- 415157
CT 8	T_8	IC-369789	CT 33	T_{33}	IC- 415159
CT 9	T_9	IC-370490	CT 34	T_{34}	IC- 415160
CT 10	T_{10}	IC-370502	CT 35	T_{35}	IC- 415161
CT 11	T_{11}	IC-370509	CT 36	T_{36}	IC- 415162
CT 12	T_{12}	IC-370715	CT 37	T_{37}	IC- 415163
CT 13	T_{13}	IC-373467	CT 38	T_{38}	IC- 415165
CT 14	T_{14}	IC-373480	CT 39	T_{39}	IC- 415168
CT 15	T_{15}	IC-373557	CT 40	T_{40}	IC- 421807
CT 16	T_{16}	IC-402293	CT 41	T_{41}	IC- 421812
CT 17	T_{17}	IC-402294	CT 42	T_{42}	IC- 421813
CT 18	T_{18}	IC-402295	CT 43	T_{43}	IC- 421814
CT 19	T_{19}	IC-402296	CT 44	T_{44}	IC- 421816
CT 20	T_{20}	IC- 402298	CT 45	T_{45}	IC- 421818
CT 21	T_{21}	IC- 402299	CT 46	T_{46}	IC- 421819
CT 22	T_{22}	IC- 402302	CT 47	T_{47}	IC- 421821
CT 23	T_{23}	IC- 415125	CT 48	T_{48}	IC- 421822
CT 24	T_{24}	IC- 415131	CT 49	T_{49}	IC- 421823
CT 25	T_{25}	IC- 415135	CT 50	T_{50}	IC- 421826

Genotypic co-efficient of variation ranged from 4.62 (days taken to maturity) to 37.28 (number of pods per cluster). Genetic advance expressed as percentage over mean ranged from 9.23 (days taken to maturity) to 74.08 (number of pods per cluster). The highest phenotypic co-efficient of variation was observed for the characters like number of branches per plant (35.56), number of clusters per plant (23.78), number of pods per cluster (38.66), fresh pod yield (22.54), dry pod yield (21.38), 100 seed weight (21.90) and gum content (22.06) and low PCV was recorded for the characters like days taken to first flowering (9.29), days to maturity (4.77), harvest index (7.69) and crude fibre content (6.39), whereas high GCV was observed for number of branches per plant (33.50), number of clusters per plant (23.62), number of pods per cluster (37.28), fresh pod yield (22.54), dry pod yield (21.37), hundred seed weight (21.89) and gum content (21.77) and low GCV for days taken to flowering (9.07), days to maturity (4.62), harvest index (7.62) and crude fibre content (6.39). In this study, the co-efficient of phenotypic and genotypic variation in respect of all the characters did not differ much in their magnitude suggesting that the characters are not much amenable to environmental factors; as such the selections may be based on phenotypic values.

The heritability portion of variation was obtained by calculating the heritability estimates and it is found to be a satisfactory tool for selection based on phenotypic performance. Heritability estimates in broad sense, do not serve as the true indicator of genetic potentiality of the genotype. Hence, it is advisable to consider the predicted genetic advance as per cent of mean along with heritability estimate as the reliable ..... *et al.*, 1955).

In the present study, high heritability associated with

Table 1 : Anova (mean sum of squares) for growth and yield performance in cluster bean genotypes

Source	DF	PH	NBPP	DTFF	NCPP	NPPC	PL	FPY	DPY
Replication	2	2.37	2.00	0.08	0.40	4.00	0.04	2.06	0.56
Genotypes	49	563.15**	12.86**	22.74**	106.53**	24.00**	1.71**	9161.61**	4633.17**
Error	98	1.78	0.52	0.36	0.49	0.58	0.01	0.37	0.57

Source	NSPP	SYPP	HSW	DTM	HI	CF	GC	CP
Replication	0.04	0.56	0.03	0.05	0.03	0.04	0.29	0.02
Genotypes	2.85**	77.97**	2.43**	23.71**	9.01**	6.55**	79.43**	15.77**
Error	0.35	0.05	0.03	0.50	0.05	0.01	0.70	0.04

** indicate significance of values at 0.01 respectively

PH- Plant height, NBPP- Number of branches per plant, DTFF- Days taken to first flowering, NCPP- Number of clusters per plant, NPPC- Number of pods per cluster, PL- Pod length, FPY- Fresh pod yield, DPY- Dry pod yield, NSPP- Number of seeds per pod, SYPP- Seed yield per plant, HSW- Hundred seed weight, DTM- Days to maturity, HI- Harvest index, CF- Crude fibre content, CP- Crude protein content, GC- Gum content.

Table 2 : General mean, range, genotypic and phenotypic variance, GCV and PCV in cluster bean

Characters	Mean	Range	Variance		GCV (%)	PCV (%)
			PV	GV		
Plant height (cm)	114.05	90.00-147.00	188.91	187.12	11.99	12.05
Number of branches per plant	6.05	2.33-9.33	4.63	4.11	33.50	35.56
Days taken to first flowering	30.10	24.67-36.00	7.82	7.45	9.07	9.29
Number of clusters per plant	25.17	17.67-35.00	35.84	35.34	23.62	23.78
Number of pods per cluster	7.49	5.00-16.00	8.39	7.80	37.28	38.66
Pod length (cm)	5.59	3.21-6.34	0.57	0.57	13.54	13.54
Fresh pod yield per plant (g)	245.15	155.67-358.33	3054.12	3053.74	22.54	22.54
Dry pod yield per plant (g)	183.83	118.67-277.00	1544.77	1544.20	21.37	21.38
Number of seeds per pod	7.87	4.33-9.00	1.19	0.83	11.59	13.87
Seed yield per plant (g)	30.99	25.33-41.53	26.02	25.97	16.44	16.46
100 seed weight (g)	4.12	2.14-6.80	0.81	0.81	21.89	21.90
Days taken to maturity	60.15	54.67-66.67	8.24	7.73	4.62	4.77
Harvest index (%)	22.68	19.43-26.50	3.04	2.98	7.62	7.69
Crude fibre content (%)	23.11	18.92-26.86	2.18	2.18	6.39	6.39
Crude protein content (%)	18.42	14.53-28.57	5.28	5.24	12.43	12.48
Gum content (%)	23.52	18.67-41.23	26.94	26.24	21.77	22.06

high genetic advance for different characters were indicative of dominance and epistatic effects (Table 3). Thus, the traits like plant height, number of branches per plant, number of clusters per plant, pod length, fresh pod yield per plant, dry pod yield per plant, seed yield per plant, hundred seed weight, days taken to maturity, crude protein and gum content recorded high heritability with high genetic advance over mean. This result is in conformity with the findings of Gipson and Balakrishnan (1990) and Singh *et al*. (2003). High heritability accompanied with high genetic advance indicated the involvement of additive genetic variance, therefore selection may be effective. Similar findings were reported by Dabas *et al*. (1982), Henry and Krishna (1990) and Arora *et al*. (2005).

Table 3 : Heritability and genetic advance as per cent of mean for 16 characters in cluster bean

Characters	Heritability (%)	Genetic advance as per cent of mean
Plant height (cm)	99.05	24.59
Number of branches per plant	88.71	65.00
Days taken to first flowering	95.33	18.24
Number of clusters per plant	98.62	48.31
Number of pods per cluster	93.03	74.08
Pod length (cm)	99.98	27.89
Fresh pod yield per plant (g)	99.99	46.43
Dry pod yield per plant (g)	99.96	44.02
Number of seeds per pod	69.84	19.96
Seed yield per plant (g)	99.80	33.83
100 seed weight (g)	99.97	45.10
Days taken to maturity	93.90	9.23
Harvest index (%)	98.06	15.54
Crude fibre content (%)	99.95	13.17
Crude protein content (%)	99.24	25.52
Gum content (%)	97.40	44.27

Thus, from the present study, the traits plant height, number of branches per plant, number of clusters per plant, number of pods per cluster, pod length, fresh pod yield per plant, dry pod yield per plant, seed yield per plant, hundred seed weight, days to maturity, crude protein and gum content could be improved through direct selection as they exhibited high (broad sense) heritability coupled with genetic advance over mean.

Conclusion :

From the foregoing discussion, it is inferred that almost all the characters, except days taken to first flowering, number of seeds per pod, days taken to maturity, harvest index and crude fibre, exhibited high heritability with high genetic advance which indicated the predominance of additive gene action. For the improvement of these traits, simple pedigree method of breeding followed by selection will reward.

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