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Variability, heritability and genetic advance analysis for yield and its contributing traits in cluster bean

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Abstract
Thirty diverse genotype of cluster bean were evaluated to study variability, heritability and Genetic Advance for yield and its contributing characters. Variation in genetic constituent leads to increasing phenotypic expression of the quantitative characters of individuals. The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) in all the characters indicating higher influence of environment. A considerable amount of variability (gcv) varied from 2.69 for days to 50% flowering to 67.57 for seed yield per plant and the estimates of pcv varied from 3.02 for days to 50% flowering to 70.65 for seed yield per plant. The genetic advance varied from 0.30 for 100-Seed weight to 27.45 for Plant height. High estimates of genetic advance were reported for plant height. However, high heritability estimates was associated with high predicted genetic advance for plant height These traits were mostly governed by additive gene action. And these characters are important for the breeder to construct selection indices.

Keywords: Variability, heritability, genetic advance and cluster bean

Introduction
Guar is an important legume crop of dryland agriculture. This crop is drought tolerant of warm weather having deep rooted system. It is summer growing annual legume. It grows well in soils with low fertility in the arid and semi-arid areas of the tropics and subtropics where the rainfall is scanty. The green pods of the crop are used as a green vegetable for human consumption while plant is used as fodder for cattle feed, meal (hull+seed coat) for non-ruminants and guar seeds are utilized for extraction of gum. Vavilov (1951) [4] has suggested that India as a geographic center of variability for guar, although it is not found to exist in wild state in this region.

Total production of guar in India is 2.46 million tonnes from an area of 5.15 million hectares with productivity being 478 kg/ha (Anonymous, 2014) [3]. Rajasthan occupies first position in area and production of guar in the country. In Rajasthan, it is cultivated on 4.56 million hectare area with the production of 2.02 million tonnes and productivity is 447 kg/ha (Anonymous, 2014) [3]. In Rajasthan, Bikaner is the leading district both in terms of area (29.1 per cent) and production (19.04 per cent).

The genetic variability provides the basis in selecting the suitable genotypes in any breeding programme. The effectiveness of selection depends on the magnitude of heritability for the traits being selected. Heritability and genetic advance are two selection parameters which were also estimated during the course of present investigation. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone. However, it is not necessary that a character showing high heritability will also exhibit high genetic advance (Johnson, et. al. 1955) [2]. Heritability is a good index of the transmission of character from parents to their offspring (Falconer, 1981) [1]. The estimates of heritability help the plant breeder in selection of elite genotypes from diverse genetic populations. Genetic advance is the measure of genetic gain under selection. The success of genetic advance under selection depends on genetic variability, heritability and selection intensity.

Materials and methods
The experimental material used in the present investigation consisted of 30 genotypes of clusterbean (Table-1) selected on the basis of their diverse geographical origin and wide variation in morphological characters. The experiment was laid out in randomized block design with three replications during kharif 2014 at Agronomy Farm,

College of Agriculture and Bikaner. Each plot comprised of two rows of 4 meter length, the spacing between row to row and plant to plant was 30 cm and 10 cm, respectively. The observations were recorded on the basis of five randomly selected plants from each replication for ten character viz.,plant height, number of branches per plant, number of clusters per plant, number of pods per plant, number of seeds per pod, pod length, 100-seed weight, biological yield per plant, harvest index and seed yield per plant while days to 50% flowering and days to maturity were recorded on plot basis. The genetic variability, heritability and genetic advance were carried out as per standard procedures.

Table 1: List of cluster bean genotypes used in the study

S. No.	Germplasm name	Source	S. No.	Germplasm name	Source
1.	RGC- 1066	ARS, Durgapura	16.	RGr -13-1	ARS, Durgapura
2.	RGC- 1038	ARS, Durgapura	17.	RGr -13-4	ARS, Durgapura
3.	RGC-986	ARS, Durgapura	18.	RGr -13-5	ARS, Durgapura
4.	RGC-1002	ARS, Durgapura	19.	RGr -13-3	ARS, Durgapura
5.	RGC-936	ARS, Durgapura	20.	RGr -12-1	ARS, Durgapura
6.	RGC-1055	ARS, Durgapura	21.	HG -2-20	CCSHAU, Hisar
7.	RGC-1033	ARS, Durgapura	22.	GAUG -003	GAU, Gujarat
8.	RGC-1003	ARS, Durgapura	23.	GAUG- 9703	GAU, Gujarat
9.	RGC-1031	ARS, Durgapura	24.	CAZG - 302	CAZRI, Jodhpur
10.	RGC-1017	ARS, Durgapura	25.	CAZG – 307	CAZRI, Jodhpur
11.	RGC-471	ARS, Durgapura	26.	HGS -884	CCSHAU, Hisar
12.	RGC-197	ARS, Durgapura	27.	HGS -26-05	CCSHAU, Hisar
13.	RGr -12-03	ARS, Durgapura	28.	HGC – 365	CCSHAU, Hisar
14.	RGr -12-5	ARS, Durgapura	29.	RGM – 114	ARS, Mandore
15.	RGr -13-2	ARS, Durgapura	30.	RGM – 115	ARS, Mandore

Results and discussion

The means of all the characters were subjected to analysis of variance for experimental design. The mean square values for the characters studied are presented in Table 2. The analysis of variance revealed significant differences among the 30 genotypes of clusterbean for all the 12 characters study except Number of pods per cluster, Pod length and 100-Seed weight indicating the presence of ample variability among the genotypes. The magnitude of PCV as expected was greater than the corresponding GCV for all the characters indicating importance of environment in expression of characters. Among all the traits high GCV and PCV were observed for seed yield per plant followed by number of branches per plant in comparison to other characters indicating the presence of high amount of genetic variability for these characters therefore selection for these characters would be effective because the response to selection is directly proportional to the variability present in the experimental material. Low GCV and PCV were observed for days to 50 per cent flowering followed by days to maturity. Similar inclinations were observed by Singh *et al*. (2003) [6]; Choudhary *et al*. (2004) [5]. In the present study the heritability in general was high (›90%) for most of the characters i.e Plant height (cm), Number of branches per plant, Number of clusters per plant, Number of pods per plant, Number of seeds per pod, Harvest index (%) and Seed yield per plant (g) While moderate heritability was recorded for i.e. days to 50 per cent flowering, days to maturity, Pod length (cm), 100- Seed weight (g). Low heritability was observed for Biological yield per plant (g). Similar estimation of heritability for various characters has been reported by Chaudhary *et al*. (2002) [8]: Patil (2014) [7].

The heritability estimates alone do not provide reliable information about the gene governing the expression of a particular character and this do not provide the information of the amount of genetic progress that would result from the selection of best individuals. Had pointed about that the heritability estimates along with genetic advance were more useful than heritability estimates alone in predicting the response to selection.

The expected genetic advance expressed as percentage of mean varied from 4.95 to 133.14. Thus, the traits like seed yield per plant, number of branches per plant, number of clusters per plant and number of pods per cluster recorded high heritability along with high genetic advance over mean suggested that genotypic variation in the present material for these characters may possibly be due to high additive genetic variance, which show the possibility for high selection efficiency. These results are in conformity with the earlier findings of Chaudhary *et al*. (1991) [10]; Singh *et al*. (2002) [33].

Conclusion

Analysis of variance revealed highly significant differences among 30 genotypes for most of the characters showing thereby considerably amount of variability among the genotypes. Genotypes having high mean performance for seed yield and other traits were identified and it was found that genotype RGr 13-4 and RGr 13-5 substantially showed higher mean values for seed yield per plant. The estimates of PCV and GCV were high for seed yield per plant followed by number of branches per plant. High heritability coupled with high genetic advance was observed for seed yield per plant followed by number of branches per plant.

Table 2: Analysis of variance for seed yield and other traits of clusterbean

Source of variation	d.f	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of clusters per plant	Number of pods per cluster	Number of seeds per pod	Pod length (cm)	100- Seed weight (g)	Biological yield per plant (g)	Harvest index (%)	Seed yield per plant (g)
Replication	2	0.17	2.17	0.54	0.06	1.22	0.01	0.04	0.06	0.01	2.79	0.78	16.56**
Genotypes	29	5.48**	27.95**	636.71**	10.70**	26.03**	1.34	2.50**	0.71	0.12	51.14**	21.92**	185.53**
Error	58	1.12	3.64	54.26	0.22	1.34	0.08	0.18	0.12	0.03	15.98	1.53	15.82

*, ** Significant at 5 % and 1 % level of significance, respectively

Table 3: Estimates of genetic parameters of variation for 12 characters of clusterbean

Characters	Mean	Range	Coefficient of variance		Heritability (%)	Genetic Advance	G.A. as % of mean
			Genotypic	Phenotypic			
Days to 50% flowering	44.71	40.66-47.00	2.69	3.02	79.59	2.21	4.95
Days to maturity	91.24	81.33-93.66	3.11	3.34	86.95	5.46	5.99
Plant height (cm)	102.30	78.53-136.00	13.62	14.24	91.48	27.45	26.83
Number of branches per plant	5.02	1.00-8.10	37.18	37.58	97.89	3.80	75.79
Number of clusters per plant	15.91	10.76-22.83	18.02	18.51	94.83	5.75	36.16
Number of pods per cluster	4.05	3.06-6.00	15.99	16.52	93.59	1.29	31.86
Number of seeds per pod	6.41	5.20-8.80	13.69	14.24	92.46	1.74	27.13
Pod length (cm)	5.37	4.40-6.26	8.23	9.07	82.32	0.82	15.38
100- Seed weight (g)	3.48	3.06-3.80	5.02	5.92	72.07	0.30	8.79
Biological yield per plant (g)	37.48	30.67-48.21	9.13	11.01	68.74	5.84	15.59
Harvest index (%)	24.22	20.74-29.30	10.76	11.15	93.02	5.18	21.38
Seed yield per plant (g)	11.13	6.86-45.33	67.57	70.65	91.47	14.81	133.14

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