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STUDIES ON VARIABILITY AND HERITABILITY IN CLUSTERBEAN

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ABSTRACT

The experiment was conducted during *Kharif*, 2014 to estimate genetic variability and genetic parameters in 48 diverse genotypes of clusterbean for 16 quantitative characters. The analysis of variance revealed significant differences among all 48 genotypes for all the characters studied. The highest estimates of coefficients of variation were registered for number of branches per plant followed by number of clusters per plant, number of pods per cluster and seed yield per plant. High heritability coupled with high genetic advance was observed for number of branches per plant and number of clusters per plant indicating the presence of additive gene action in the expression of these characters. High estimates of genotypic coefficient of variation, heritability and genetic advance recorded for number of branches per plant and number of clusters per plant indicated that variation in these traits is high and these traits appear to be governed by additive gene action. Hence, simple directional selection may be effective to improve these traits.

KEYWORDS: Heritability, Variability, Clusterbean.

INTRODUCTION

Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub] (2n = 14) commonly known as guar is grown in *Kharif* season in arid and semi arid regions of India. It is a drought hardy and deep rooted annual legume. Guar is one of the most important and potential vegetable cum industrial crop grown for its tender pods for vegetable purpose and for endospermic gum. Like other legumes, guar is an excellent soil-building crop with respect to nitrogen fixation. Root nodules contain nitrogen-fixing bacteria and crop residues, when ploughed under, improves yields of succeeding crops.

In recent years guar has achieved the status of an industrial crop due to the water soluble natural polymer galactomannon gum. Now guar has become an alternative remunerative crop with high adaptability suited for growing in arid regions of the world. Gum having good binding properties is derived from the endosperm of the seed. Guar gum is an important ingredient in producing food emulsifier, food additive, food thickener and other guar gum products. Its usage as a thickening agent and emulsifier in the oil and gas extraction industry for hydraulic fracturing of sub-surface shale has made it a much sought after product in international market.

Despite its importance, only limited breeding work has been done and very little attention has been given for clusterbean genetic improvement in the past. Hence, there is a need to enhance the productivity levels of cluster bean. Progress in breeding for economic characters depends largely on the magnitude and nature of the variability present in germplasm. An insight into the magnitude of variability present in a crop species and heritability of characters is essential to select potential genotypes from breeding populations as it provides the basis for effective selection. Hence, in the present study an attempt was made to elucidate information on the nature and magnitude of genetic variation observed for seed yield, yield components and quality traits in 48 clusterbean genotypes.

MATERIAL AND METHODS

The material for the present investigation comprising of 48 genotypes of clusterbean were obtained from Rajasthan Agriculture Research Institute, Durgapura, Rajasthan. The experiment was laid out in a randomized block design with three replications, during *Kharif*, 2014 at Dryland farm of S.V. Agricultural College, Tirupati. Each genotype was sown in a single row of 6 m length adopting recommended spacing of 45 × 30 cm. Fertilizers were applied at recommended dose of 20 Kg N and 40 Kg P_2O_5 per hectare in the form of urea and single super phosphate. Weeding and plant protection operations were taken up as and when needed during the crop growth period and life saving irrigation was given to raise a good crop.

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The data was recorded on five randomly selected plants per genotype per replication for 16 characters viz., days to 50% flowering, days to maturity, plant height, number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, pod weight, pod length, number of seeds per pod, 100 seed weight, shelling percentage, endosperm percentage, gum percentage, pod yield per plant and seed yield per plant. The data was subjected to statistical analysis. Analysis of variance was worked according to the method outlined by Panse and Sukhatme (1961). The genotypic (GCV) and phenotypic (PCV) coefficient of variation was calculated by the formulae given by Burton (1952). Heritability in broad sense [h^2(b)] was calculated by the formula given by Lush (1940). Genetic gain as per cent of mean was calculated by the formula given by Johnson *et al*. (1955a).

RESULTS AND DISCUSSION

The analysis of variance showed significant differences among the genotypes for all the 16 characters studied (Table 1). The range, general mean, variance, heritability and GAM are presented in the Table 2. A wide range of variability was recorded for characters viz., plant height (116.00-191.33), number of branches per plant (0.00-11.67), number of clusters per plant (15.33-87.67), number of pods per plant (78.13-200.02), shelling percentage (31.76-53.42), pod yield per plant (32.18-77.38) and seed yield per plant (11.60-33.69).

In the present study, phenotypic variance was higher than genotypic variance for all the characters studied (Table 2). Phenotypic coefficient of variation ranged from 3.62 (days to maturity) to 41.16 (number of clusters per plant). Genotypic coefficient of variation ranged from 2.51 (endosperm percentage) to 38.36 (number of branches per plant). The estimates of heritability ranged from 30.26 (pod length) to 89.78 (days to maturity). Genetic advance expressed as percentage over mean ranged from 3.12% (pod length) to 73.76% (number of branches per plant).

The highest estimates of coefficients of variation were registered for number of branches per plant followed by number of clusters per plant, number of pods per cluster and seed yield per plant. Moderate estimates of genotypic coefficient of variation and higher estimates of phenotypic coefficient of variation were observed for number of pods per plant followed by pod yield per plant, pod weight, while shelling percentage and plant height registered moderate estimates of both GCV and PCV, whereas low estimates of coefficient of variation were recorded for characters 100-seed weight, days to 50% flowering, days to maturity, number of seeds per pod, pod length, gum percentage and endosperm percentage.

The results indicated more scope of selection for improvement of characters viz., number of branches per plant, number of pods per cluster, number of clusters per plant and seed yield per plant which registered higher estimates of GCV and PCV. These results are in accordance with the findings of Singh *et al.* (2004), Saini *et al*. (2005) for number of branches per plant, number of clusters per plant and seed yield per plant. Anandhi and Oommen (2007) and Muthuselvi and Shanthi (2013) also observed high GCV and PCV for number of pods per cluster. On contrary, endosperm percentage, gum percentage, number of seeds per pod, days to maturity, pod length, days to 50% flowering and 100-seed weight recorded lower estimates of GCV and PCV indicating little scope for selection of these traits. Similar results were reported by Reddy and Gupta (1984) for endosperm percentage. Low GCV and PCV were earlier reported by Chaudhary and Singh (1976) and Singh *et al*. (2005) for days to 50% flowering and 100 seed weight.

In the present study, high heritability associated with high genetic advance as per cent of mean was observed for number of branches per plant and number of clusters per plant which indicated that the inheritance of these traits is most likely due to additive gene action. These results are in correspondence with the findings of Saini *et al*. (2010) and Muthuselvi and Shanthi (2013) for number of branches per plant and number of clusters per plant.

High heritability coupled with low genetic advance as per cent of mean was observed for days to 50% flowering and days to maturity indicating the non additive gene action hence, selection for days to 50% flowering and days to maturity may not be rewarding.

From the results obtained in present investigation, it is evident that number of branches per plant and number of clusters per plant had high genotypic coefficient of variation (GCV) and high heritability coupled with high genetic advance indicating that variation in these traits is high and most likely these traits are governed by additive gene effects.

Table 1. Analysis of variance for 16 characters in 48 Clusterbean genotypes

S. No.	Character	Mean sum of squares		
		Replications (df=2)	Genotypes (df=47)	Error (df=94)
1.	Days to 50% flowering	1.02	4.26**	0.48
2.	Days to maturity	1.58	33.20**	1.21
3.	Plant height (cm)	1244.91	1042.00**	359.03
4.	Number of branches per plant	2.84	25.25**	1.19
5.	Number of clusters per plant	36.92	534.20**	51.33
6.	Number of pods per cluster	0.80	2.60**	0.67
7.	Number of pods per plant	55.46	2260.07**	461.34
8.	Pod weight (g)	0.006	0.023**	0.0093
9.	Pod length (cm)	0.023	0.104**	0.045
10.	Number of seeds per pod	0.15	0.29**	0.10
11.	100-seed weight (g)	0.016	0.180**	0.054
12.	Shelling percentage (%)	4.29	87.62**	22.29
13.	Endosperm percentage (%)	1.07	4.46**	1.40
14.	Gum percentage (%)	0.82	4.50**	1.42
15.	Pod yield per plant (g)	136.64	329.00**	94.70
16.	Seed yield per plant (g)	16.01	79.14**	21.00

Ample variation was observed in the traits viz., number of pods per cluster and seed yield per plant as indicated by high GCV. Further, these traits registered moderate heritability coupled with high GAM suggesting that these traits are also governed by additive gene action and hence simple selection may be effective in the improvement of these traits also.

Moderate variability and moderate heritability was reported for the traits number of pods per plant, pod yield per plant, plant height, pod weight and shelling percentage. The high GAM indicated additive gene action for number of pods per plant and pod yield per plant. Whereas moderate GAM for plant height, pod weight and shelling percentage indicated the role of additive and non-additive gene action for these traits. These results suggested that careful selection may be helpful in the improvement of these traits.

Low GCV values exhibited by pod length, number of seeds per pod, 100 seed weight, endosperm percentage, gum percentage, days to 50% flowering and days to maturity and the low GAM recorded for these traits suggested lesser scope of improvement of these traits by phenotypic selection as these traits are governed by non-additive gene action.

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Table 2. Mean, Range, variability and genetic parameters for 16 characters in clusterbean

S. No.	Character	Mean	Range		Variance		Coefficient of Variation		Heritability (Broad sense) (%)	Genetic advance (GA)	Genetic advance as percent of mean (%)
			Min	Max	Genotypic	Phenotypic	Genotypic	Phenotypic			
1.	Days to 50% flowering	27.46	25.00	30.67	1.26	1.74	4.09	4.81	72.35	1.97	7.17
2.	Days to maturity	95.17	88.33	100.00	10.66	11.88	3.43	3.62	89.78	6.37	6.70
3.	Plant height (cm)	144.19	116.00	191.33	227.65	586.69	10.46	16.80	38.80	19.36	13.43
4.	Number of branches per plant	7.38	0.00	11.67	8.02	9.20	38.36	41.11	87.10	5.45	73.76
5.	Number of clusters per plant	35.40	15.33	87.67	160.95	212.29	35.84	41.16	75.82	22.76	64.28
6.	Number of pods per cluster	3.84	2.83	6.90	0.64	1.31	20.92	29.85	49.13	1.16	30.21
7.	Number of pods per plant	132.91	78.13	200.02	599.58	1060.91	18.42	24.51	56.52	37.92	28.53
8.	Pod weight (g)	0.42	0.28	0.68	0.005	0.014	16.13	28.07	33.00	0.08	19.08
9.	Pod length (cm)	5.10	4.61	5.66	0.02	0.06	2.75	5.00	30.26	0.16	3.12
10.	Number of seeds per pod	7.48	6.68	8.17	0.06	0.16	3.35	5.43	38.09	0.32	4.26
11.	100 seed weight (g)	3.36	2.86	3.94	0.04	0.10	6.13	9.23	44.06	0.28	8.38
12.	Shelling percentage (%)	41.04	31.76	53.42	21.78	44.07	11.37	16.17	49.41	6.76	16.46
13.	Endosperm percentage (%)	40.24	37.53	43.82	1.02	2.42	2.51	3.87	42.05	1.35	3.35
14.	Gum percentage (%)	37.98	35.28	41.57	1.03	2.45	2.67	4.12	41.93	1.35	3.56
15.	Pod yield per plant (g)	52.50	32.18	77.38	78.10	172.80	16.83	25.04	45.20	12.24	23.31
16.	Seed yield per plant (g)	21.54	11.60	33.69	19.38	40.38	20.44	29.50	48.00	6.28	29.17

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