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Research Article

ASSESSMENT OF GENETIC VARIABILITY AND CHARACTER ASSOCIATION IN CLUSTERBEAN [*Cyamopsis tetragonoloba* L. Taub.]

PATEL K.V.[1], PARMAR D.J.[2], CHAVADHARI R.L.[3], MACHHAR R.G.[3] AND PATEL H.P.[1]
[1]Pulse Research Station, Vadodara, 390003, Anand Agricultural University, Anand, 388110, Gujarat, India
[2]Department of Statistics, B.A. College of Agriculture, Anand Agricultural University, Anand, 388110, Gujarat, India
[3]Agricultural Research Station, Derol, 389330, Anand Agricultural University, Anand, 388110, Gujarat, India
*Corresponding Author: Email- hirenubi@gmail.com

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Abstract: Cluster bean [*Cyamopsis tetragonoloba* L. Taub.] has the potential of supplying a protein and cultivated as a vegetable, gum and as a green manuring crop. Due to its better and fine gum qualities it is considered as an important cash crop for industrial gum production. Current aim to study the variability, correlation and path analysis between the varieties and promising local selection to establish selection criteria which might help to develop genotype having high potential and identify yield contributing characters. The experiment was conducted at Agriculture Research Station, Anand Agricultural University, Derol (PMS), Gujarat in kharif 2017. Twenty-two genotypes evaluated through 10 characters. Analysis of variance indicated sufficient variability present in studied material for all 10 characters. On the basis of per se performance genotype RCG-1002 (1.50 kg/plot) and DRLGG-13-8 (1.48 kg/plot) are high yielding and also at par with other eight genotypes. Pods per plant showed high heritability couple with high genetic advance means selection is effective through this character. PCV is higher than GCV value indicates environment influence on these traits. Yield per plant should significant and positive correlation with primary branches per plant, clusters per plant and pods per plant whereas negative correlation with days to flowering, days to maturity and pods per cluster. It was observed that cluster per plant (11.04) has maximum positive direct effects on yield per plot followed by days to 50% flowering, days to maturity, plant stand and pods per plant. Character like clusters per plant followed by primary branches per plant show positive correlation with high direct effect, hence use such character for direct selection of genotypes for increasing the yield per plot.

Keywords: Cluster bean, Variability, Correlation, Path analysis

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Introduction

Cluster bean [*Cyamopsis tetragonoloba* L. Taub.] (2n = 14) is a versatile and multipurpose legume crop of arid and semiarid regions cultivated for feed, fodder and manure. Cluster bean enhances soil productiveness by fixing atmospheric nitrogen for its own necessitates and also for the succeeding crop. Although cluster bean is a minor crop but due to its better and finer guar gum qualities it is considered as an important cash crop for industrial gum production. This is a drought tolerant annual legume crop cultivated mainly in marginal and sub marginal soils receiving low rainfall. In North Indian states like Rajasthan, Haryana, Gujarat and Punjab is mainly cultivated guar for gum production and for forage, whereas in South India it is being cultivated for vegetable purpose. These characters are themselves interrelated. Such inter-dependence of the contributing factors affects their direct relationship with yield, thereby making correlation coefficients unreliable as selection indices [1]. A study of correlation and path analysis between quantitative characters provides an idea of association of characters. To have a clear picture of yield components for effective selection, it is desirable to consider the relative magnitude of various characters contributing toward yield. Path coefficient helps in building the correlation towards yield. The path coefficient analysis provides a more realistic evidence of the interrelationship, as it considers direct and indirect effects of the variables by partitioning the correlation coefficients. In this consideration, present study conducted for study variability and it inter and intra relationship between quantitative traits.

Material and Methods

All the cluster bean genotypes collected from different parts of India are evaluated in randomized complete block design with two replications at Agriculture Research Station, Anand Agricultural University, Derol (PMS), Gujarat during Kharif season 2017. Each genotype was sown 4 m row length in two replications with spacing of 45 cm between rows and 10 cm between plants. Yield and nine yield attributed characters viz., Yield per plot, 50% flowering, Days to maturity, Plant stand, Plant height, Primary branches, Cluster per plant, Pods per cluster, Seeds per pod, Pods per plant were recorded on five randomly selected plants in each replication. The mean data were subjected to statistical analysis for estimating variability, phenotypic and genotypic coefficient of variation using formula [2]. Heritability in broad sense and genetic advance was estimated by using the method [3, 4]. The phenotypic and genotypic correlation coefficients for pair of the characters were worked-out through covariance analysis [5]. The genotypic path coefficient analysis was done as per the method [6] by using Window Stat software program.

Result and Discussion

A group of twenty-two varieties and promising lines of cluster bean were constituted to assess the genetic parameters for exploitation of genetic variability [Table-1]. To know the performance of locally collected five land races against release varieties of Gujarat and other state. The analysis of variance for yield and yield attributing characters were analyzed and presented in [Table-2].

Table-1 Source and information of cluster bean genotypes use in present study

S	Genotypes	Source	S	Genotypes	Source
1	GG-1	SDAU, Gujarat	12	RCG-1002	ARS, Durgapur
2	GG 2	SDAU, Gujarat	13	RCG-1031	ARS, Durgapur
3	BG-1	IGFRI, Jhansi	14	RCG-1033	ARS, Durgapur
4	BG-2	IGFRI, Jhansi	15	RCG-1033	ARS, Durgapur
5	BG-3	IGFRI, Jhansi	16	RCG-1055	ARS, Durgapur
6	HG- 2-20	CCSHAU, hisar	17	Pusabahar	IARI, New Delhi
7	HG-75	CCSHAU, hisar	18	DRLGG 13-7	Local Germplasm
8	HG-119	CCSHAU, hisar	19	DRLGG 13-8	Local Germplasm
9	HG-365	CCSHAU, hisar	20	DRLGG 13-26	Local Germplasm
10	HG-832	CCSHAU, hisar	21	DRLGG 13-27	Local Germplasm
11	HG-870	CCSHAU, hisar	22	DRLGG 13-38	Local Germplasm

Table-2 Analysis of variance for yield and yield attributes in cluster bean genotypes

Source of variation/ character Growth parameters	Replication	Genotype
Df	2	21
Yield/plot	0.0379	0.0585*
50% flowering	5.1094*	19.5465*
Maturity	2.7500	46.8750*
Plant stand	5.8125	413.5238*
Plant Height	179.2188	161.8661*
Primary branches	0.8745	8.3853*
Cluster per plant	149.1133	127.3092*
Pods per cluster	0.0227	3.8331*
Seeds per pod	0.0581	1.1519*
Pods per plant	476.5000	578.9345*

Table-3 Mean performance of cluster bean genotypes in different quantitative traits

Genotypes	Yield/ Plot	50% flowering	Maturity	Plant stand	Plant Height	Primary branches	Cluster per plant	Pods per cluster	Seeds per pod	Pods per plant
GG-1	1.20	44.50	104.00	170.00	107.60	12.00	43.30	4.50	9.40	98.20
GG 2	1.00	38.50	97.00	157.50	88.80	11.00	36.60	5.50	7.70	74.40
BG-1	1.27	40.50	102.50	164.00	103.10	11.10	45.10	6.20	8.00	105.90
BG-2	1.34	43.50	104.50	158.00	102.20	8.90	32.20	4.00	7.80	77.80
BG-3	1.12	43.00	105.00	154.00	102.40	10.20	30.10	4.50	8.30	70.50
HG- 2-20	1.35	41.00	104.00	143.50	113.10	11.40	32.90	3.60	6.80	90.00
HG-75	1.16	37.00	97.50	149.50	103.60	10.40	46.60	5.40	7.90	97.70
HG-119	1.46	40.00	98.50	156.50	107.60	9.50	37.40	4.00	8.10	97.60
HG-365	1.13	41.00	97.50	163.50	103.50	11.30	42.50	4.40	7.80	98.00
HG-832	1.34	37.00	97.50	140.50	97.60	12.20	54.70	7.00	8.70	115.60
HG-870	1.40	37.50	96.50	138.00	105.30	11.40	47.30	5.00	7.40	124.60
RCG-1002	1.50	43.50	99.50	154.00	106.90	11.80	45.70	5.00	7.50	141.50
RCG-1031	1.37	44.00	100.50	180.50	93.30	7.60	33.50	3.80	8.80	110.50
RCG-1033	1.46	40.50	103.50	147.50	90.30	9.70	45.30	6.30	7.60	101.50
RCG-1033	1.20	43.50	105.00	151.50	98.70	8.50	32.10	4.30	6.70	90.50
RCG-1055	1.36	43.00	105.50	147.00	95.60	9.50	35.00	7.40	9.30	99.90
Pusabahar	1.01	42.50	107.00	161.50	103.50	9.10	42.40	5.30	7.80	104.70
DRLGG 13-7	1.08	44.00	107.50	139.00	100.90	11.00	29.10	5.20	8.00	92.60
DRLGG 13-8	1.48	48.00	112.50	139.50	112.30	9.80	34.70	4.40	8.00	83.60
DRLGG 13-26	1.03	49.00	114.50	143.00	120.20	10.20	32.80	3.80	8.90	83.40
DRLGG 13-27	1.15	42.00	105.50	124.00	122.00	8.20	38.40	8.10	9.30	98.20
DRLGG 13-38	0.95	40.00	104.00	117.50	119.50	2.70	19.00	8.20	7.20	72.90
S.Em.	0.09	0.52	0.83	8.66	5.24	1.02	4.62	0.51	0.42	7.50
CD (p=0.05)	0.26	1.53	2.43	25.46	15.40	2.99	13.59	1.51	1.22	22.07
CV %	10.2	1.6	1.1	8.2	7.1	14.5	17.2	13.7	7.3	11

Table-4 Variability parameters for major yield and yield components in Cluster bean

Particular	Yield/ plot	50% flowering	Maturity	Plant stand	Plant Height	Primary branches	Cluster per plant	Pods per cluster	Seeds per Pod	Pods per plant
Heritability	0.57	0.95	0.94	0.47	0.49	0.61	0.50	0.76	0.54	0.67
Genetic Advance(K=2.06)	0.23	6.18	9.54	16.18	10.59	2.85	9.45	2.31	0.96	25.83
GCV	11.72	7.34	4.62	7.66	7	17.98	17.1	24.42	7.89	15.77
PCV	15.52	7.55	4.76	11.19	9.96	23.12	24.24	28.02	10.76	19.21

Table-5 Genotypic and phenotypic correlation coefficients of different characters in Cluster bean

Characters		Yield/ plot	50% flowering	Maturity	Plant stand	Plant Height	Primary branches	Cluster per plant	Pods per cluster	Seeds per pod	Pods per plant
Yield/plot	Rg	1	-0.016	-0.218	0.331	-0.253	0.483*	0.716**	-0.193	0.044	0.738**
	Rp	1	0.009	-0.169	0.074	-0.171	0.192	0.203	-0.207	-0.063	0.396**
50% flowering	Rg		1	0.86**	0.119	0.398	-0.069	-0.473*	-0.417*	0.336	-0.222
	Rp		1	0.824**	0.117	0.261	-0.089	-0.424**	-0.370**	0.249*	-0.234
Maturity	Rg			1	-0.341	0.559**	-0.238	-0.627**	-0.082	0.232	-0.491*
	rp			1	-0.196	0.364**	-0.223	-0.421**	-0.095	0.184	-0.376**
Plant stand	rg				1	-1.019**	0.448*	0.297	-0.83	0.244	0.18
	rp				1	-0.317**	0.307*	0.247*	-0.431**	0.093	0.192
Plant Height	rg					1	-0.708**	-0.597**	0.058	-0.004	-0.337
	rp					1	-0.045	-0.139	0.084	0.113	-0.036
Primary branches	rg						1	0.741**	-0.477*	0.096	0.362
	rp						1	0.64**	-0.297*	0.139	0.425*
Cluster per plant	rg							1	0.111	0.265	0.695**
	rp							1	0.048	0.109	0.723**
Pods per cluster	rg								1	0.341	0.128
	rp								1	0.145	0.019
Seeds per pod	rg									1	0.052
	rp									1	0.059
Pods per plant	rg										1
	rp										1

Table-6 Direct (diagonal) and indirect path effects of different traits on seed yield per plant in cluster bean

	50% flowering	Maturity	Plant stand	Plant Height	Primary branches	Cluster per plant	Pods per cluster	Seeds per pod	Pods per plant	Correlation with yield
50% flowering	4.963	1.104	0.117	-0.357	0.426	-5.21	-0.264	-1.52	0.726	-0.016
Maturity	4.266	1.284	-0.335	-0.502	1.473	-6.908	-0.052	-1.05	1.605	-0.218
Plant stand	0.589	-0.438	0.982	0.915	-2.77	3.272	-0.526	-1.104	-0.589	0.331
Plant Height	1.974	0.718	-1.001	-0.898	4.38	-6.583	0.037	0.018	1.102	-0.253
Primary branches	-0.341	-0.306	0.44	0.635	-6.189	8.168	-0.303	-0.436	-1.185	0.483
Cluster per plant	-2.345	-0.805	0.292	0.536	-4.586	11.024	0.07	-1.198	-2.273	0.716
Pods per cluster	-2.068	-0.106	-0.816	-0.052	2.954	1.224	0.634	-1.545	-0.419	-0.193
Seeds per pod	1.666	0.298	0.239	0.004	-0.596	2.916	0.216	-4.529	-0.17	0.044
Pods per plant	-1.102	-0.63	0.177	0.302	-2.242	7.659	0.081	-0.236	-3.271	0.738

The analysis of variance exhibited significant differences among the genotypes for all the characters under study indicated presence of sufficient genetic variability among varieties of Gujarat and other state as well as local landraces. Varietal mean performance for ten characters is presented in [Table-3]. It was observed from the result that RCG-1002 (1.50 kg/plot) and DRLGG-13-8 (1.48 kg/plot) produce highest yield among all tested genotypes. Early maturing genotype GG-2 (38.50 days) produce less yield (1.0 kg/plot) which indicates late mature genotype attend more height and vegetative growth compared to early mature one. None of the genotype show highest value for all characters means yield is a complex character which depends on several independent quantitative characters. Variability parameters for all ten characters in cluster bean genotypes are presented in [Table-4]. Days to 50% flowering, days to maturity, primary branches per plant, pods per cluster and pods per plant were highly heritable character and it was 0.95, 0.94, 0.61, 0.76 and 0.67 respectively. Yield per plant, plant height, clusters per plant and seeds per pod account medium heritability. High heritability indicates major part of variability was due to genetic factor but it doesn't mean it is heritable to next generation. Here, broad sense heritability estimates include role of dominance variance and which is not heritable in nature so in such cases, genetic advance is consider as valuable parameter. The genetic advanced calculated and results presented in [Table-4]. The data revealed that high genetic advance (>20%) was recorded for pods per plant (25.83%) while moderate (>10%) estimates for plant height (10.59%) and other all characters have GA less than 10%. Pods per plant have high heritability with high genetic advanced whereas yield per plot have moderate heritability with moderate GA. In Gujarat, PCV were higher than GCV for all ten characters which demonstrated the effect of environment upon the expression of the characters [Table-4]. Lush, (1949) [4] reported similar result. These results are also similar to [6-8] which indicate that greater the genetic variability among the parents, more are the chances of further improvement. A high estimate of PCV (>20%) was observed for primary branches per plant, cluster per plant and pods per cluster. The high GCV was observed for pods per cluster which is indicated the presence of exploitable variability for this character. Moderate GCV and PCV observed for primary branches per plant, clusters per plant, pods per plant and yield per plot which revealed that considerable scope for improvement of these characters in desirable direction through selection programme. Estimates of genotypic correlation coefficient between seed yield and yield contributing characters were found to be higher than their corresponding phenotypic correlation coefficient for all characters and similar trend was observed for both phenotypic and genotypic correlation coefficient [Table-5]. Day to 50% flowering, days to maturity, plant height and pods per cluster were shown a negative correlation with yield per plot whereas positive and significant correlation was observed between yield per plot and primary branches per plant, number of clusters per plant, seeds per pod and pods per plant which are valuable yield contributing attributes which were supported with results of [9-11]. Plant height and days to maturity showed positive and significant correlation which was indicates late maturing genotypes grow taller and also gave high yield. Among all characters, pods per plant and clusters per plant are highly significant and positively correlated at genotypic and phenotypic level concluded that indirect selection for pods per plant, clusters per plant and primary branches per plant

would be effective for the development of high yielding cluster bean varieties.
Path coefficient analysis was carried out using correlation coefficient to determine the direct and indirect influence of nine characters. Estimates of direct and indirect effects of nine yield contributing characters in presented in [Table-6]. Days to 50% flowering, days to maturity, plant stand, clusters per plant, pods per cluster were show positive direct effect on yield while plant height, primary branches per plant, seeds per pod and pods per plant were show direct negative effect on yield. The result was postulated that high yielding cluster bean genotype will be obtained by selecting plant with a greater number of clusters per plant whereas character like primary branches per plant and pods per plant show positive and significant correlation but negative direct effect on yield and positive indirect effect on yield through days to flowering, days to maturity and plant height.

Conclusion

Genetic variability, correlation and path analysis were carried out for twenty-two cluster bean genotypes. Genetic effects were highly significant for all the traits under study. Pods per plant have high heritability coupled with high genetic advance which was indicates character may be govern by additive gene action. PCV value is higher than GCV value which indicates environment played a vital role in expression of characters.

Application of research: Correlation coefficient revealed that yield per plot was positive and significantly correlated with primary branches per plant, number of clusters per plant and pods per plant. Among yield contributing characters, the highest positive direct effect was observed between yield and number of clusters per plant and pods per cluster but pods per cluster shown negative correlation with yield. For identify high yielding genotype, direct selection based on clusters per plant would be more effective.

Research Category: Genetic and plant Breeding

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***Principle Investigator or Chairperson of research: Dr HP Patel**
University: Anand Agricultural University, Anand, 388110, Gujarat
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