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Short Communication

Genetic Variation in Morphological Traits and their Interrelationship with Gum Content and Yield in Clusterbean

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Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub], a neglected arid legume for long time, has attained a special place at commercial level because of its gum content. It has a great potential in uplifting the economy of the poor masses of arid and semi-arid regions. Studies on genetic parameters can help in developing a scheme for selection of high gum yielding guar varieties. Although, genetic improvement depends on nature and extent of variability present in the existing material and heritability pattern of the desirable characters, the knowledge on the relative contribution of gum and yield components and their direct and indirect effects are of immense value in selection of superior genotypes. Therefore, present study was undertaken to assess genotypic variability, heritability and genetic advance for seed yield and gum content and their components. The correlation and path coefficient analysis were undertaken to understand the characters associated and the extent and nature of direct and indirect effect of component traits on gum content.

The experimental material consisted of 40 genotypes of clusterbean. The genotypes were evaluated in a randomized block design with three replications at CR Farm, Central Arid Zone Research Institute, Jodhpur, during kharif 2005, 2006 and 2007. Each genotype was grown in three row plot of 4 m length with row to row and plant to plant spacing of 30 cm and 10 cm, respectively. The data for days to 50% flowering were recorded on plot basis, whereas plant height, number of primary branches, number of secondary branches, number of seeds pod^{-1}, number of pods plant^{-1}, 100-seed weight, seed yield plant^{-1}, endosperm and gum content were recorded in five randomly selected competitive plants. Data were subjected to analysis of variance, phenotypic and genotypic coefficient of variation (Burton, 1952; Singh and Choudhary, 1996). Broad sense heritability (h^2) and genetic advance (GA) was estimated from replicated plot means as per Johnson *et al*. (1955). Path coefficient analysis was done using phenotypic correlation coefficient following Dewey and Lu (1959).

The analysis of variance showed significant genotypic differences for all the characters studied indicating the presence of sufficient variability in the material. The phenotypic coefficient of variation (PCV) was invariably slightly higher than their corresponding genotypic coefficient of variation (GCV) indicating variability in these characters may not only be due to genotypes, but environment also influenced expression of these characters (Table 1). Singh *et al.* (2005) also observed similar trends for PCV and GCV in clusterbean. The PCV was highest for number of primary branches (45.43%) followed by seed yield (31.07%), number of seeds pod^{-1} (17.98%) and number of pods plant^{-1} (21.58%). It was moderate for gum content, endosperm, days to 50% flowering and plant height, and was low for 100-seed weight. High magnitude of GCV was recorded for number of primary branches (43.89%), seed yield (27%) and number of pods plant^{-1} (21.42%). It was moderate for endosperm, days to 50% flowering and number of seeds pod^{-1} and low for 100-seed weight and plant height.

The heritability in conjunction with genetic advance is more useful than heritability alone in prediction of the resultant effect of selecting the best individual (Johnson *et al*., 1955). In the present investigation heritability ranged from 24.2% for plant height to 98.5% for number of pods plant^{-1}. The high value of heritability for number of pods plant^{-1} (98.5%), endosperm (95.2%), days to 50% flowering (92.9%) and number of primary branches (93.3%) demonstrated that they are least influenced by environmental changes (Pathak, 2008). Moderate values of gum content, seed yield and 100-seed weight suggested that to some extent environment influenced the expression of these traits. Low values for plant height and number of seeds per pod indicated that these traits are highly influenced by environmental changes.

The higher estimates of heritability coupled with higher genetic advance for number of primary

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Table 1. Mean, range and coefficient of variations for various traits in clusterbean

Variability parameters	Days to 50% flowering	Plant height (cm)	No. of primary branches	No. of secondary branches	No. of seeds pod^{-1}	No. of Pods plant^{-1}	100-seed weight (g)	Seed yield plant^{-1} (g)	Endo-sperm (%)	Gum content (%)
Heritability (%)	92.9	24.2	93.3	84.4	40.0	98.5	76.7	75.5	95.2	62.9
GA mean %	21.9	5.4	87.4	57.7	14.7	43.8	11.7	48.3	24.6	17.8
GCV	11.0	5.3	43.9	30.5	11.3	21.4	6.5	27.0	12.2	10.9
PCV	11.4	10.7	45.4	33.2	18.0	21.6	7.4	31.1	12.5	13.7
ECV	3.0	9.3	11.7	13.1	14.0	2.6	3.6	15.4	2.7	8.4
Mean	32.3	35.7	10.1	16.2	8.3	32.2	2.9	7.8	39.6	29.4
Minimum	30.3	31.8	7.6	10.8	7.3	21.1	2.57	5.4	30.4	23.9
Maximum	35.8	43.4	13.1	26.0	9.4	44.9	3.06	11.0	46.3	34.2

branches, number of pods plant^{-1}, seed yield plant^{-1}, days to 50% flowering and endosperm indicated the high contribution of additive gene effects. The results suggest that simple direct selection may be effective using these traits. High heritability accompanied with medium to low genetic advance for plant height, number of seeds pod^{-1}, 100-seed weight and gum content indicates non-additive gene action. The finding was in agreement with other reports (Singh *et al*., 2005; Choudhary and Bhatnagar, 1995).

Seed yield plant^{-1} had highly significant and positive correlation with number of pods plant^{-1}, number of seeds pod^{-1}, number of secondary branches, plant height and number of primary branches (Table 2). The findings were in agreement with earlier workers in clusterbean (Singh *et al*., 2001, 2005; Chaudhary *et al*., 2001; Chaudhary and Bhatnagar, 1995).

Endosperm had highly significant and positive correlation with gum content and 100-seed weight. The association of number of primary branches was also highly significant and had positive correlation with number of secondary branches.

The path analysis is suitable method to understand the direct and indirect causes of association between independent and dependent variables. Number of pods plant^{-1} (0.32), endosperm (0.27), number of secondary branches (0.13) and days to 50% flowering (0.11) had direct positive effect on gum content. Whereas, plant height exerted maximum negative direct effect (-0.34). Number of primary branches, number of secondary branches, number of pods plant^{-1} and seed yield per plant indirectly negatively and 100-seed weight indirectly and positively affected gum content via plant height. Plant height, number of secondary branches plant^{-1} and seed yield plant^{-1} indirectly and positively affected gum content via number of pods plant^{-1}. The findings are in agreement with the earlier reports in clusterbean (Singh *et al*., 2005; Chaudhary *et al*., 2001).

The partitioning of phenotypic correlation coefficient of various traits revealed that number of pods plant^{-1} had maximum direct effect (0.85) followed by number of seeds pod^{-1} (0.28) and 100-

Table 2. Correlation Matrix for different traits in clusterbean

Parameter	1	2	3	4	5	6	7	8	9	10
1. Days to 50% flowering	1.00	0.05	-0.20 **	-0.04	0.11	0.01	0.08	0.11	0.09	0.06
2. Plant height (cm)		1.00	0.74 **	0.82 **	0.23 **	0.59 **	-0.55 **	-0.12	-0.06	0.48 **
3. No. of primary branches plant^{-1}			1.00	0.76 **	0.00	0.48 **	-0.60 **	-0.10	0.01	0.29 **
4. No. of secondary branches plant^{-1}				1.00	0.11	0.64 **	-0.51 **	-0.10	0.03	0.49 **
5. No. of seeds pod^{-1}					1.00	0.23 **	0.21 **	-0.08	-0.07	0.53 **
6. No. of pods plant^{-1}						1.00	-0.18 **	-0.04	0.11	0.89 **
7. 100-seed weight (g)							1.00	0.20 **	0.04	0.12
8. Endosperm (%)								1.00	0.29 **	-0.02
9. Gum (%)									1.00	0.08
10. Seed yield plant^{-1} (g)										1.00

** P<0.01

seed weight (0.23). Plant height (0.50), number of primary branches (0.40), number of secondary branches (0.54), number of seeds pod^{-1} (0.19) and gum content (0.10) influenced seed yield via number of pods plant^{-1} indirectly. 100-seed weight showed negative indirect effect on seed yield, but via plant height (-0.12), number of primary branches (-0.14) and number of secondary branches (-0.12). Gum content showed low negative direct effect on seed yield, but via number of pods per plant it influenced the seed yield.

The correlation of plant height, number of primary branches, number of secondary branches, number of seeds pod^{-1} and number of pods plant^{-1} with seed yield was highly significant and positive. Out of these traits only number of pods plant^{-1} and number of seeds pod^{-1} mainly contributed directly as evident from partial R^2 value of 0.76 and 0.15, respectively. The other three traits viz., plant height, number of primary branches and number of secondary branches have contributed via indirect effects. The study validates that the number of pods, number of branches are important traits for improvement of seed yield and endosperm for improving gum content in clusterbean.

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