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Short Communication

Genetic Variability and Character Association Study in Indo-African Derivatives of Pigeonpea

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Pigeonpea {*Cajanus cajan* (L.) Millsp.} still supports the characters of wild plant despite under cultivation since long. The early maturity with low spread of the plant, determinate growth habit, resistance to biotic and abiotic stresses are some of the characters that have been improved in cultivated plant type. As such, the country has been harvesting almost the same level of production of pigeonpea in lesser number of days than what it used to harvest earlier making lot of land available for other crops. The plateau and stagnation in pigeonpea productivity has become an issue of national concern and was discussed in many brain storming sessions at different levels with little success. Several reasons for low productivity have been assigned (Jeswani, 1986), among which conventional breeding procedures with narrow genetic base have been the major bottlenecks for genetic improvement. Therefore, present investigation is an attempt to study genetic variability and character association among different yield attributing traits in 64 Indo-African derivatives of pigeonpea with broad genetic base.

With an objective to broaden the narrow genetic base, exotic lines from Kenya (ICP-9140 and ICP-9135), Tanzania (ICP-12116 and ICP-12161), Myanmar (ICP-11488) and Canada (ICP-13555) and diverse indigenous genotypes (GT-100, GT-101, Banas and ICP-11912) were crossed in diallel fashion. From F_5 generation of Indo-African derivatives, 64 IPS (single plant progenies) were selected on the basis of number of branches, pod color, seeds per pod, plant type, flower color, stem color, leaf thickness and maturity duration during kharif 2007. These 64 IPS were evaluated for characterization under field condition during kharif 2008. These were grown in a single row plot of 4 m length spaced 60 cm apart with plant to plant distance of 30 cm. Each IPS was replicated thrice in Randomized Complete Block Design. All recommended agronomical practices were followed. The observations were recorded on plant height, number of branches plant^{-1}, number of pods plant^{-1}, pod length, number of seeds pod^{-1}, days to 50% flowering, days to maturity, 100-seed weight, and grain yield plant^{-1}.

The data were subjected to the analysis of variance using plot means. Genetic coefficient of variation was estimated as per Burton (1952). Broad sense heritability was calculated according to method reported by Burton and De Vane (1953). The expected genetic advance was calculated by using the formula as suggested by Johnson *et al.* (1955). The data were also analyzed for estimating the correlation coefficient (Al-Jibouri *et al.*, 1958) and path analysis (Dewey and Lu, 1959) for grain yield per plant and its contributing characters.

Mean values of population, range, genetic and phenotypic coefficient of variability, heritability (broad sense) and genetic advance as per cent of mean for different quantitative characters suggested a wide range of variation in the population under study (Table 1). A very close connection between the estimates of GCV and PCV was noted specially in case of plant height, number of pods plant^{-1}, days to 50% flowering, days to maturity and 100-seed weight. Grain yield plant^{-1}, number of pods plant^{-1} and number of branches plant^{-1} recorded high GCV and PCV estimates. Similar high estimates for these traits were reported by Basavarajaiah *et al.* (2000), Gohil (2006) and Singh *et al.* (2008). Low estimates of GCV and PCV recorded for days to maturity, days to 50% flowering, number of seeds pod^{-1} and pod length culminated into low genetic advance. Heritability (in broad sense) estimates were quite high for all the characters studied. Consequent up on environmental fluctuations, the genotypic coefficient of variation alone may not be sufficient to measure the magnitude of heritable variation. Therefore, heritability coupled with genetic advance should be considered and given more weightage. High heritability coupled with high genetic advance was observed for grain yield plant^{-1}, number of pods plant^{-1} and number of branches plant^{-1} indicating the predominance of

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Table 1. Phenotypic range, treatment mean, phenotypic and genotypic coefficient of variation, heritability (broad sense) and genetic advance for different characters for 9 different traits in 64 IPS of pigeonpea

Character	Mean ± SEm	Phenotypic range	GCV (%)	PCV (%)	HBS (%)	GA (% mean)
Plant height (cm)	128.85 ± 0.27	67.4-210.2	20.49	20.66	98.40	41.88
Number of branches plant^{-1}	5.98 ± 0.30	1.5-12.4	45.16	45.59	98.10	92.31
Number of pods plant^{-1}	80.40 ± 0.28	25.4-203.7	46.20	46.40	99.10	94.76
Pod length (cm)	4.58 ± 0.20	3.2-7.0	19.10	19.85	92.60	37.77
Number of seeds pod^{-1}	4.13 ± 0.17	2.9-5.4	15.88	16.62	91.30	31.23
Days to 50% flowering	114.26 ± 0.12	91.0-138.7	11.26	11.33	98.70	23.05
Days to maturity	162.60 ± 0.12	138.7-192.3	9.15	9.19	99.00	18.75
100-seed weight (g)	10.92 ± 0.17	3.8-16.4	20.93	21.02	99.20	42.95
Grain yield plant^{-1} (g)	29.51 ± 0.12	11.2-75.3	52.09	58.22	99.20	119.01

GCV = Genotypic coefficient of variance PCV = Phenotypic coefficient of variance
HBS = Heritability in broad sense GA % mean = Genetic advance as percent of mean

Table 2. Genotypic and phenotypic correlation coefficients among nine different characters in 64 IPS of pigeonpea

Characters	r	Number of branches plant^{-1}	Number of pods plant^{-1}	Pod length (cm)	Number of seeds pod^{-1}	Days to 50% flowering	Days to maturity	100-seed weight (g)	Grain yield plant^{-1} (g)
Plant height (cm)	r_g	0.168*	0.336**	0.271**	0.307**	0.224**	0.221**	-0.003	0.396**
	r_p	0.164*	0.333**	0.257**	0.293**	0.222**	0.216**	0.003	0.390**
Number of branches plant^{-1}	r_g		0.587**	0.020	0.239**	-0.531**	-0.530**	-0.066	0.423**
	r_p		0.580**	0.022	0.225**	0.523**	-0.525**	-0.063	0.416**
Number of pods plant^{-1}	r_g			0.040	0.190**	-0.221**	-0.206**	-0.003	0.846**
	r_p			0.040	0.181*	0.218**	-0.205**	-0.003	0.839**
Pod length (cm)	r_g				0.722**	0.214**	0.204**	0.120	0.329**
	r_p				0.649**	0.209**	0.194**	0.116	0.317**
Number of seeds pod^{-1}	r_g					-0.011	0.006	0.001	0.467**
	r_p					-0.012	0.001	0.002	0.442**
Days to 50% flowering	r_g						0.985**	-0.090	-0.134
	r_p						0.976**	-0.090	-0.132
Days to maturity	r_g							-0.058	-0.096
	r_p							0.059	-0.096
100-seed weight (g)	r_g								0.293**
	r_p								0.291**

*, ** = Significant at 5% and 1% level of probability, respectively.

Table 3. Path coefficient analysis showing direct and indirect effect of eight casual variables on grain yield per plant of 64 IPS of pigeonpea

Character	Plant height (cm)	Number of branches plant^{-1}	Number of pods plant^{-1}	Pod length (cm)	Number of seeds pod^{-1}	Days to 50% flowering	Days to maturity	100-seed weight (g)	Correlation with grain yield plant^{-1} (g)
Plant height (cm)	**0.034**	0.023	0.287	0.018	0.084	-0.092	0.089	-0.001	0.396**
Number of branches plant^{-1}	0.006	**0.137**	0.501	0.001	0.065	0.218	-0.214	-0.017	0.423**
Number of pods plant^{-1}	0.011	0.080	**0.853**	0.003	0.052	0.091	-0.083	-0.001	0.846**
Pod length (cm)	0.009	0.003	0.034	**0.065**	0.197	0.088	0.083	0.032	0.329**
Number of seeds pod^{-1}	0.010	0.033	0.163	0.047	**0.273**	0.004	0.003	0.000	0.467**
Days to 50% flowering	0.008	0.073	0.188	0.014	0.003	**-0.411**	0.0398	0.024	-0.134
Days to maturity	0.008	0.073	0.176	0.013	0.002	0.405	**0.404**	0.015	-0.096
100-seed weight (g)	0.000	0.009	0.003	0.008	0.000	0.037	0.023	**0.265**	0.293**

Figures in bold letters indicate the direct effects.
Residual effect = 0.0805

additive gene effects. Therefore, selection based on phenotypic performance will be quite effective for these traits. Similar results were reported for seed yield per plant by Basavarajaiah *et al.* (2000), for seed yield per plant and number of pods per plant by Gohil (2006) and for seed yield per plant and primary branches per plant by Singh *et al.* (2008).

Grain yield was found to be significantly and positively correlated with plant height, number of branches plant^{-1}, number of pods plant^{-1}, pod length, number of seeds pod^{-1} and 100-seed weight indicating that these characters manifested the grain yield in pigeonpea (Table 2). Thus, an ideal plant type in pigeonpea may comprise more number of branches bearing good number of pods having bold seeds. Significant and positive correlation of seed yield plant^{-1} with plant height was reported by Singh *et al.* (2008).

Path coefficient analysis (Table 3) revealed that number of pods plant^{-1} had the highest positive direct effect on grain yield plant^{-1} and hence selection based on this trait could increase the grain yield. Similar results of high direct effect of days to maturity on yield were observed by Kumar and Reddy (1982). The other characters viz., plant height, number of branches plant^{-1}, pod length, number of seeds pod^{-1} and 100-seed weight possessed positive, but low direct effect on grain yield. Indirect association of all the characters among themselves was weak. The residual effect was positive and low (0.0805), indicating that characters included in the present study cover most of the variation and other characters than the one studied had very little role towards improvement of yield potential in pigeonpea. Therefore, the emphasis in order of preference can be laid on number of pods plant^{-1}, pod length, number of seeds pod^{-1} and 100-seed weight during selection in segregating generations for improvement of yield in pigeonpea.

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