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STUDIES ON GENETIC PARAMETERS AND INTER-RELATIONSHIPS AMONG YIELD AND YIELD CONTRIBUTING TRAITS IN PIGEONPEA [*CAJANUS CAJAN* (L.) MILLSP.]

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ABSTRACT

Experiment was conducted on pigeonpea to study the genetic variability, association among the yield component traits, their direct and indirect effects on the yield. Genotypic coefficient of variation was played a major role for the expression of the traits ranged from 1.47 (days to 50 per cent flowering) to 48.13 (grain yield). Heritability in narrow sense ranged from 17.16 (harvest index) to 72.01 (100-seed weight). High genetic advance was observed for the traits, number of primary branches/plant (20.51), number of secondary branches/plant (28.99), leaf area (24.56), number of pods/plant (49.95), pod bearing zone (25.89), pollen viability (62.88) and grain yield (2376.05) coupled with low heritability, indicating the preponderance of the non-additive gene action; suggesting that hybridization breeding will be effective. Number of primary branches/plant (0.345*), number of secondary branches/plant (0.464**), number of pods/plant (0.806**), pod bearing zone (0.433**), harvest index (0.787**) and pollen viability (0.721**) exhibited positive and significant correlation with the grain yield along with their positive and high direct effects ranged from 0.060 to 0.430, suggesting that these traits can be strategically used to improve the yield of pigeonpea.

INTRODUCTION

Pulses occupy an important place in Indian agriculture. Within this protein-rich group of crops, red gram or pigeonpea [*Cajanus cajan* (L.) Millsp.] occupies an important place among rainfed resource poor farmers because it provides quality food, fertilizer, fuel wood and fodder. Its soil rejuvenation qualities like release of soil-bound phosphorous with the presence of root exudates pyssidic acid, fixation of atmospheric nitrogen, recycling of soil nutrients, addition of organic matter and nutrients make pigeonpea an ideal crop for sustainable agriculture in the tropical and sub-tropical region of India.

Pigeonpea is globally grown on 5.2m ha of land in about 50 countries, of the 77 percent area is in India and more than 80 percent red gram is being consumed by India (FAO-2008). Since 1976, pigeonpea has globally recorded 56 percent increase in its area and production but the productivity has remained low at 700 kg/ha. This is a matter of concern since the domestic demand of pigeonpea is rapidly increasing in India and the Indian Government is importing 0.5-0.6 million tons of pigeonpea every year.

The per capita availability of protein in the country is 28 g/day and in the state of Bihar only 19 g/day, while as per WHO recommendation it should be 80 g/day, consequently the problem of malnutrition existing among the poor people. The total production could be enhanced either by making horizontal expansion in area, which is not possible owing to high population growth, so none of the option left other than vertical expansion, which could be done opting a suitable breeding method.

Seed yield is the result of the expression and association of several plant growth components, which contribute additively or help in some conditions to modifying the expression of other traits directly or indirectly. The main objective for a plant breeder is to evolve high yielding varieties. It is therefore, desirable for plant breeder to know the extent of relationship between yield and its various components, which will facilitate selection based on component traits. Path analysis is a standardised partial regression coefficient measuring the direct influence of one variable upon the other and permits separation of correlation coefficient into components of direct and indirect effects. Correlation and path coefficient could be necessary tools at the disposal of the breeder in pigeonpea improvement programme for enhancing the production and productivity (Salahuddin *et al.,* 2010).

MATERIALS AND METHODS

The present study comprised of four cytoplasmic genetic male sterile lines (female) viz., ICP-2043A, ICP-2092A, HY-4A and H-28A as well as seven testers (males) viz., Bahar, NDA-1, P-9, MAL-13, DA-11, MAL-28 and IPA-203. The crossing programme was carried out in line x tester fashion at Tirhut College of Agriculture, Dholi during kharif 2010-11. Eleven parents along with their 28 hybrids were sown in a randomized block design with three replications during kharif 2011-12. Each entry was sown in two rows of 3 meters length with a spacing of 70 x 30cm row to row and plant to plant. Observations on five randomly selected competitive plants

Table 1: Analysis of variance for 17 characters in pigeonpea

Sl.No.	Characters	Mean sum of Squares Replication(df = 2)	Treatments(df = 38)	Error(df = 76)
1.	Days to 1st Flowering	48.85	30.02**	13.07
2.	Days to 50% Flowering	7.15	32.87**	10.61
3.	Days to Last Flowering	28.06	56.11**	10.41
4.	Days to Maturity	7.96	87.42**	20.87
5.	Plant Height (cm)	323.60	672.15**	121.27
6.	No. of Primary branches/plant	62.13	13.55**	3.70
7.	No. of Secondary branches/plant	12.16	40.77**	5.38
8.	Leaf Area (cm^2)	0.09	9.23**	0.95
9.	No. of Pods/Plant	2401.10	35455.51**	2828.41
10.	Pod Bearing Zone (cm)	7.02	83.06**	6.51
11.	Pod Length (cm)	0.18	0.34**	0.06
12.	Pod Width (cm)	0.001	0.010**	0.0004
13.	No. of Grains/Pod	0.05	0.19**	0.03
14.	100-Seed Weight (g)	0.11	4.06**	0.32
15.	Harvest Index (%)	5.51	66.16**	3.00
16.	Pollen Viability Test (%)	5.37	1738.67**	9.31
17.	Grain Yield (Kg/ha)	16798.62	2586319.73**	40434.47

**significant at P = 0.01

Table 2: Range and mean of 17 characters in pigeonpea

Sl.No.	Characters	Range	Mean	CV (%)
1.	Days to 1st Flowering	145.00-158.33	152.40	2.37
2.	Days to 50% Flowering	179.67-195.33	185.38	1.76
3.	Days to Last Flowering	215.67-230.33	221.38	1.46
4.	Days to Maturity	237.33-261.67	249.84	1.82
5.	Plant Height (cm)	184.03-239.87	213.48	5.16
6.	No. of Primary branches/plant	8.83-18.23	12.48	15.41
7.	No. of Secondary branches/plant	14.70-28.60	20.22	11.47
8.	Leaf Area (cm^2)	7.99-15.34	12.02	8.10
9.	No. of pods/plant	117.67-556.57	383.17	13.88
10.	Pod Bearing Zone (cm)	24.37-48.40	35.88	7.11
11.	Pod Length (cm)	4.86-6.49	5.54	4.34
12.	Pod Width (cm)	0.62-0.90	0.80	2.42
13.	No. of Grains/Pod	3.40-4.50	3.89	4.68
14.	100-Seed Weight (g)	9.23-14.50	11.33	5.02
15.	Harvest Index (%)	0.84-20.66	13.10	13.21
16.	Pollen Viability test (%)	8.33-90.00	59.27	5.15
17.	Grain Yield (Kg/ha)	84.67-4073.00	1914.17	10.51

Table 3: Estimation of genetic parameters of 17 characters of pigeonpea

Sl.No.	Characters	$\acute{o}2$ p	$\acute{o}2$ g	PCV	GCV	Heritability (Narrow sense)	Genetic advance	Genetic Advance as % of mean
1.	Days to 1st Flowering	18.72	5.65	2.84	1.56	51.77	2.69	1.77
2.	Days to 50% Flowering	18.03	7.42	2.29	1.47	60.28	3.60	1.94
3.	Days to Last Flowering	25.64	15.23	2.29	1.76	61.83	6.20	2.80
4.	Days to Maturity	43.05	22.18	2.63	1.89	28.52	6.96	2.79
5.	Plant Height (cm)	304.90	183.63	8.18	6.35	46.22	21.66	10.15
6.	No. of Primary branches/plant	6.99	3.28	21.17	14.52	45.47	2.56	20.51
7.	No. of Secondary branches/plant	17.18	11.80	20.49	16.98	45.30	5.86	28.99
8.	Leaf Area (cm^2)	3.71	2.76	16.02	13.82	70.22	2.95	24.56
9.	No. of pods/plant	13704.11	10875.70	30.55	27.22	60.21	191.38	49.95
10.	Pod Bearing Zone (cm)	32.02	25.52	15.77	14.08	46.78	9.29	25.89
11.	Pod Length (cm)	0.15	0.09	7.01	5.51	65.76	0.49	0.63
12.	Pod Width (cm)	0.004	0.003	7.54	7.14	30.47	0.11	0.14
13.	No. of Grains/Pod	0.08	0.05	7.45	5.79	35.86	0.36	0.46
14.	100-Seed Weight (g)	1.57	1.25	11.06	9.85	72.01	2.05	2.63
15.	Harvest Index (%)	24.05	25.05	37.43	35.02	17.16	8.84	11.33
16.	Pollen Viability test (%)	585.76	576.45	40.83	40.51	40.91	49.07	62.88
17.	Grain Yield (kg/ha)	889062.90	848628.40	49.26	48.13	40.19	1854.04	2376.05

Table 4: Phenotypic and Genotypic Correlation coefficient between 17 component characters of Pigeonpea

Sl.No	Character		Days to 1st Flowering	Days to 50 % Flowering	Days to Last Flowering	Days to Maturity	Plant Height (cm)	No. of Primary Branches /plant	No. of Secondary Branches/ plant	LeafArea (cm²)	No. of pods/ Plant	Pod Bearing Zone (cm)	PodLength (cm)	Pod Width (cm)	No. of Grains/ Pod	100Seed Weight (g)	Harvest) Index(%	Pollen Viabiliy test	Grain Yield (Kg/ha)
1.	Days to 1st Flowering	P	1.000	0.371*	0.308	0.292	0.006	-0.323*	0.077	0.209	0.138	-0.117	0.206	0.113	0.159	0.169	-0.060	-0.032	-0.042
		G	1.000	1.240	0.497	0.733	-0.120	-0.436	-0.044	0.465	0.278	-0.135	0.604	0.239	0.681	0.443	-0.020	-0.075	-0.029
2.	Days to 50% Flowering	P		1.000	0.138	0.492**	-0.083	-0.093	0.052	0.174	0.233	0.008	0.298	0.052	0.264	0.138	0.162	0.116	0.066
		G		1.000	0.454	0.760	-0.092	-0.401	0.086	0.484	0.405	0.023	0.559	0.066	0.430	0.313	0.093	0.189	0.078
3.	Days to Last Flowering	P			1.000	0.160	0.209	0.134	0.044	0.201	0.220	0.389*	0.069	0.183	0.149	0.042	0.046	0.070	0.017
		G			1.000	0.300	0.236	0.252	0.049	0.231	0.306	0.454	0.055	0.243	0.404	-0.040	0.061	0.075	0.043
4.	Days to Maturity	P				1.000	-0.108	-0.038	0.094	0.040	0.078	0.035	0.183	0.179	0.057	0.130	0.045	0.092	-0.009
		G				1.000	-0.125	-0.083	0.059	0.160	0.071	-0.002	0.222	0.244	0.148	0.190	0.049	0.143	-0.033
5.	PlantHeight (cm)	P					1.000	0.210	-0.019	-0.005	0.171	0.131	0.022	-0.006	0.023	-0.175	0.071	0.158	0.086
		G					1.000	0.136	-0.018	0.006	0.209	0.120	-0.054	-0.004	0.032	-0.200	0.141	0.196	0.111
6.	No. of Primary branches/plant	P						1.000	0.207	-0.326*	0.272	0.463**	-0.056	0.108	-0.027	-0.256	0.311	0.153	0.345*
		G						1.000	0.258	-0.540	0.280	0.662	-0.291	0.209	-0.007	-0.379	0.519	0.229	0.432
7.	No.of Secondary branches/plant	P							1.000	-0.125	0.356*	0.115	0.017	-0.165	0.015	-0.064	0.136	0.184	0.464**
		G							1.000	-0.183	0.413	0.126	-0.073	-0.204	0.025	-0.082	0.219	0.231	0.555
8.	LeafArea (cm²)	P								1.000	0.177	-0.045	0.147	-0.052	0.040	0.444**	-0.096	0.292	-0.033
		G								1.000	0.159	-0.092	0.169	-0.069	0.032	0.511	-0.118	0.335	-0.055
9.	No. of pods/Plant	P									1.000	0.496**	0.215	-0.154	0.010	0.079	0.636**	0.715**	0.806**
		G									1.000	0.544	0.251	-0.174	0.078	0.109	0.816	0.812	0.856
10.	Pod BearingZone (cm)	P										1.000	-0.054	0.156	0.024	-0.003	0.480**	0.423**	0.433**
		G										1.000	-0.154	0.174	0.039	-0.056	0.603	0.480	0.462
11.	Pod Length (cm)	P											1.000	0.086	0.468**	0.309	0.143	0.058	0.204
		G											1.000	0.066	0.585	0.358	0.153	0.080	0.220
12.	Pod Width (cm)	P												1.000	0.155	0.058	0.067	-0.125	-0.151
		G												1.000	0.168	0.064	0.035	-0.138	-0.159
13.	No. ofGrains/Pod	P													1.000	-0.097	0.000	-0.181	0.003
		G													1.000	-0.170	-0.040	-0.249	0.019
14.	100-SeedWeight (g)	P														1.000	-0.047	0.228	0.024
		G														1.000	-0.060	0.250	0.032
15.	HarvestIndex (%)	P															1.000	0.706**	0.787**
		G															1.000	0.763	0.859
16.	PollenViability test (%)	P																1.000	0.721**
		G																1.000	0.750

*Significant at P = 0.05; ** Significant at P = 0.01

were recorded for days to 1st flowering, days to 50 per cent flowering, days to last flowering, days to maturity, plant height (cm), number of primary branches/ plant, number of secondary branches/ plant, leaf area (cm²), number of pods/ plant, pod bearing zone (cm), pod length (cm), pod width (cm), number of grains/ pod, 100-seed weight (g), harvest index (per cent), pollen viability (per cent) and grain yield (kg/ha). Phenotypic and genotypic correlation coefficients were worked out for all possible combination of characters as per procedure outlined by Al-Jibouri *et al*. (1958). Path analysis was carried out following the method suggested by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Significant differences among the genotypes were observed for all the traits under study as evident from the Table 1; indicating that presence of sufficient variability among the experimental materials.

Days to 1st flowering ranged from 145.0 to 158.3 comprising the general mean of 152.4 days as per the table-2; indicating that majority of genotypes in experiment are delayed in days to 1st flowering, days to 50 per cent flowering ranged 179.7 to 195.3 days having the general mean of 185.4 days, which is closer to the early genotype, days to last flowering varies 215.7 to 230.3 days with the general mean of 221.4; days to maturity ranged from 237.3 to 261.7 days comprising the general mean 249.8 days; suggesting that most of the genotypes, belong to late maturity group, plant height varied from 184.0 to 239.9 (cm) having the general mean 213.5 (cm); it showed that all the genotypes are having the tall stature, number of primary branches/plant varied from 8.8 to 18.2 with a general mean of 12.5; suggesting that very few genotypes are closer to the higher range of traits, number of secondary branches/plant varied from 14.7 to 28.6 having the general mean of 20.2; suggesting that most of the trait, the moderate number of secondary branches/plant, leaf area varied from 8.0 to 15.3 (cm²) with the general mean of 12.0 (cm²); indicating that majority of genotypes having the broader leaf; number of pods/plant ranged from 117.7 to 556.6 pods with the general mean of 383.2 pods, revealed that majority of the

Table 5: Direct and Indirect effects of 16 component traits on grain yield of Pigeonpea

Sl.No.	Character		Days to 1st Flowering	Days to 50 % Flowering	Days to Last Flowering	Days to Maturity	Plant Height (cm) plant	No. of Primary branches/ plant	No. of Secondary branches/	LeafArea (cm^2)	No. of pods/ Plant	Pod Bearing Zone (cm)	Pod Length (cm)	Pod Width (cm)	No. of Grains/ Pod	100Seed Weight (g)	Harvest Index (%)	Pollen Viability test (%)	Grain Yield (Kg/ha)
1.	Days to 1st Flowering	P	-0.008	-0.003	-0.002	-0.002	0.000	0.003	-0.001	-0.002	-0.001	0.001	-0.002	-0.001	-0.001	-0.001	0.001	0.000	-0.042
		G	0.027	0.034	0.014	0.020	-0.003	-0.012	-0.001	0.013	0.008	-0.004	0.016	0.007	0.019	0.012	-0.001	-0.002	-0.029
2.	Days to 50 % Flowering	P	-0.045	-0.120	-0.017	-0.059	0.010	0.011	-0.006	-0.021	-0.028	-0.001	-0.036	-0.006	-0.032	-0.017	-0.020	-0.014	0.066
		G	0.280	0.226	0.102	0.172	-0.021	-0.091	0.019	0.109	0.091	0.005	0.126	0.015	0.097	0.071	0.021	0.043	0.078
3.	Days to Last Flowering	P	-0.020	-0.009	-0.064	-0.010	-0.013	-0.009	-0.003	-0.013	-0.014	-0.025	-0.004	-0.012	-0.010	-0.003	-0.003	-0.004	0.017
		G	0.058	0.053	0.116	0.035	0.027	0.029	0.006	0.027	0.036	0.053	0.006	0.028	0.047	-0.005	0.007	0.009	0.043
4.	Days to Maturity	P	-0.009	-0.015	-0.005	-0.030	0.003	0.001	-0.003	-0.001	-0.002	-0.001	-0.006	-0.005	-0.002	-0.004	-0.001	-0.003	-0.009
		G	-0.263	-0.273	-0.108	-0.359	0.045	0.030	-0.021	-0.057	-0.025	0.001	-0.080	-0.087	-0.053	-0.068	-0.018	-0.051	-0.033
5.	PlantHeight (cm)	P	-0.000	0.003	-0.007	0.004	-0.032	-0.007	0.001	0.000	-0.006	-0.004	-0.001	0.000	-0.001	0.006	-0.002	-0.005	0.086
		G	0.002	0.002	-0.005	0.003	-0.020	-0.003	0.001	-0.000	-0.004	-0.002	0.001	0.000	-0.001	0.004	-0.003	-0.004	0.111
6.	No of primary branches/plant	P	-0.020	-0.006	0.008	-0.002	0.013	0.060	0.013	-0.020	0.016	0.028	-0.003	0.007	-0.002	-0.015	0.019	0.009	0.345*
		G	-0.055	-0.051	0.032	-0.011	0.017	0.127	0.033	-0.069	0.036	0.084	-0.037	0.026	-0.001	-0.048	0.066	0.029	0.432
7.	No. of Sec. Branches/plant	P	0.018	0.012	0.010	0.022	-0.004	0.048	0.231	-0.029	0.082	0.027	0.004	-0.038	0.003	-0.015	0.031	0.042	0.464**
		G	-0.018	0.035	0.020	0.024	-0.007	0.104	0.403	-0.074	0.166	0.051	-0.030	-0.082	0.010	-0.033	0.088	0.093	0.555
8.	LeafArea (cm^2)	P	-0.010	-0.009	-0.010	-0.002	0.000	0.016	0.006	-0.049	-0.009	0.002	-0.007	0.003	-0.002	-0.022	0.005	-0.014	-0.033
		G	-0.045	-0.047	-0.022	-0.016	-0.001	0.053	0.018	-0.097	-0.016	0.009	-0.017	0.007	-0.003	-0.050	0.012	-0.033	-0.055
9.	No. of pods/Plant	P	0.054	0.091	0.085	0.030	0.066	0.106	0.138	0.069	0.389	0.193	0.084	-0.060	0.004	0.031	0.247	0.278	0.806**
		G	-0.105	-0.153	-0.115	-0.027	-0.079	-0.106	-0.156	-0.060	-0.377	-0.205	-0.095	0.066	-0.029	-0.041	-0.308	-0.306	0.856
10.	Pod BearingZone (cm)	P	0.004	-0.001	-0.014	-0.001	-0.005	-0.017	-0.004	0.002	-0.018	-0.036	0.002	-0.006	-0.001	0.000	-0.017	-0.015	0.433**
		G	0.022	-0.004	-0.074	0.001	-0.020	-0.108	-0.021	0.015	-0.089	-0.164	0.025	-0.028	-0.006	0.009	-0.099	-0.079	0.462
11.	PodLength (cm)	P	0.016	0.023	0.005	0.014	0.002	-0.004	0.001	0.011	0.016	-0.004	0.076	0.007	0.036	0.024	0.011	0.004	0.204
		G	0.051	0.047	0.005	0.019	-0.005	-0.025	-0.006	0.014	0.021	-0.013	0.085	0.006	0.050	0.030	0.013	0.007	0.220
12.	PodWidth (cm)	P	-0.007	-0.003	-0.011	-0.011	0.001	-0.007	0.010	0.003	0.009	-0.009	-0.005	-0.060	-0.009	-0.004	-0.004	0.008	-0.151
		G	-0.023	-0.006	-0.023	-0.023	0.001	-0.020	0.019	0.007	0.017	-0.017	-0.006	-0.095	-0.016	-0.006	-0.003	0.013	-0.159
13.	No. ofGrains/Pod	P	0.007	0.012	0.007	0.003	0.001	-0.001	0.001	0.002	0.001	0.001	0.022	0.007	0.046	-0.004	0.000	-0.008	0.003
		G	0.045	0.029	0.027	0.010	0.002	-0.001	0.002	0.002	0.005	0.003	0.039	0.011	0.066	-0.011	-0.003	-0.017	0.019
14.	100-SeedWeight (g)	P	0.007	0.005	0.002	0.005	-0.007	-0.010	-0.003	0.017	0.003	-0.000	0.012	0.002	-0.004	0.038	-0.002	0.009	0.024
		G	0.044	0.031	-0.004	0.019	-0.020	-0.037	-0.008	0.050	0.011	-0.006	0.035	0.006	-0.017	0.098	-0.006	0.025	0.032
15.	HarvestIndex (%)	P	-0.026	0.070	0.020	0.020	0.031	0.134	0.059	-0.041	0.274	0.206	0.062	0.029	0.000	-0.020	0.430	0.303	0.787**
		G	-0.015	0.069	0.045	0.037	0.105	0.386	0.163	-0.088	0.606	0.448	0.113	0.026	-0.030	-0.045	0.743	0.567	0.859
16.	PollenViability test (%)	P	-0.004	0.015	0.009	0.012	0.021	0.020	0.024	0.038	0.094	0.056	0.008	-0.017	-0.024	0.030	0.093	0.132	0.721**
		G	-0.034	0.086	0.034	0.065	0.089	0.105	0.105	0.153	0.371	0.219	0.037	-0.063	-0.114	0.114	0.349	0.457	0.750

Residual effect: Phenotypic (P) = 0.354; Genotypic (G) = 0.253

genotypes comprising were having the high number of pods/plant being a hybrid; pod bearing zone varied from 24.4 to 48.4 (cm) comprising the general mean 35.9 (cm), which indicates that maximum genotypes were having the long pod bearing zone; pod length and pod width ranged 4.9 to 6.5 (cm) and 0.6 to 0.9 (cm) having the general mean 5.5 and 0.8 (cm) respectively, number of grains/pod varied from 3.4 to 4.5 pods and most of the genotypes were having the four grains/pod as evident from the general mean; 100-seed weight ranged from 9.2 to 14.5 (g) and majority of genotypes were having the 11 to 12 (g), 100-seed weight; harvest index varied from 0.8 to 20.7 per cent with the general mean of 13.1 per cent; suggesting that most of the genotypes having low harvest index, pollen viability ranged from 8.3 to 90.0 per cent with the general mean of 59.0 per cent indicating that most of the genotypes were having good pollen viability being the restorer of hybrid; grain yield ranged from 84.7 to 4073.0 kg/ ha with general mean of 1914.2 kg/ ha; indicating that very few genotypes were having the higher yield. This finding is corroborated with Pandey and Singh (2002), Linge *et al*. (2010) and Sreelakshmi *et al*. (2011).

Phenotypic coefficient of variation (PCV) was slightly higher in magnitude then the genotypic coefficient of variation (GCV), suggesting that for the expression of the traits in the study were least influenced by the environment as revealed by the Table 3. Lowest magnitude of PCV and GCV was observed for the traits, days to 1st flowering, days to 50 per cent flowering, days to last flowering and days to maturity, while higher magnitude of PCV and GCV was observed for number of primary/ secondary branches/plant, leaf area, number of pods/plant, pod bearing zone, harvest index, pollen viability and grain yield, indicating that for these traits genotypes differ from each other for the expression of the characters. All the traits exhibited low heritability in narrow sense except leaf area and 100 - seed weight. Low genetic advance as per cent of mean

was observed for ten characters viz., days to 1st flowering, days to 50 per cent flowering, days to last flowering, days to maturity, plant height, pod length, pod width, number of grains/pod, 100-seed weight and harvest index; where as, high genetic advance as per cent of mean was observed for the traits, number of primary/secondary branches/plant, leaf area, number of pods/plant, pod bearing zone, pollen viability and grain yield. Since all above traits were comprising the low to high genetic advance as per cent of mean coupled with the low heritability, suggesting that there is a preponderance of non-additive gene action, so in this case for the grain yield enhancement of the pigeonpea, hybridization breeding will be rewarding. Similar results were also obtained by Romeis *et al*. (1999), Bhadru (2010), Linge *et al*. (2010) and Sreelakshmi *et al*. (2011).

Days to 1st flowering exhibited positive and significant correlation with days to 50 per cent flowering, where as it is negatively and significantly correlated with the number of primary branches as evident from Table 4; suggesting that early variety may have lower number of primary branch/plant, days to 50 per cent flowering showed positive and significant correlation with days to maturity indicating that early flowering genotype will get matured early and late flowering genotype get matured late, days to last flowering had showed positive and significant correlation with pod bearing zone, suggesting that wider range of flowering period is directly associated with the length of the pod bearing zone; number of primary branch/ plant exhibited negative and significant correlation with leaf area, where as it had positive and significant correlation with pod bearing zone and grain yield; number of secondary branches/plant exhibited positive and significant correlation with number of pods/plant and grain yield; leaf area was found to be positively and significantly associated with 100-seed weight; number of pods/plant strongly positively and significantly associated with pod bearing zone, harvest index, pollen viability and grain yield; pod bearing zone was found to be positively and significantly associated with harvest index, pollen viability and grain yield; pod length had showed positive and significant correlation with number of grains/pod; harvest index exhibited strong positive and significant correlation with pollen viability and grain yield, positive and significant correlation was also obtained between pollen viability and grain yield. Similar results were also reported by Dani (1979), Singh *et al*. (1981), Romeis *et al*. (1999) and Linge *et al*. (2010).

Number of primary branches, number of secondary branches, number of pods/plant, pod bearing zone, harvest index and pollen viability showed significant and positive correlation along with their positive and high direct effect on grain yield as evident from the Table 5; suggesting that these characters may be considered during the course of selection to enhance the production and productivity of pigeonpea. Similar results were also obtained by Chandirakala and Raveendran (1998), Srinivas *et al*. (1999), Firoz Mahamad *et al*. (2006), Mahajan *et al*. (2007), Satish Kumar *et al*. (2006) and K. Baskaran and A. R. Muthiah (2007). As evident from Table 5, very meagre phenotypic and genotypic residual effect were obtained 0.354 and 0.253 respectively, suggesting that most of the yield and yield contributing traits were studied in present investigation and very few of them yet to be studied.

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