# Genetic divergence, traits association, path analysis and harvest index in pigeonpea (*Cajanus Cajan L.*)

Basudev Satapathy, Kaushik Kumar Panigrahi,
Puranjaya Panigrahi, Ayesha Mohanty, Purandar Mandal and Abhiram Dash


ISSN: 0975-928X
Volume: 10
Number:3

EJPB (2019) 10(3):1223-1233
DOI:10.5958/0975-928X.2019.00155.8

https://ejplantbreeding.org

Electronic Journal of Plant Breeding, 10 (3): 1223 - 1233(Sep2019) DOI: 10.5958/0975-928X.2019.00155.8
ISSN 0975-928X

**Research Article**

# Genetic divergence, traits association, path analysis and harvest index in pigeonpea (*Cajanus Cajan L.*)

**Basudev Satapathy[1], Kaushik Kumar Panigrahi[2]*, Puranjaya Panigrahi[1], Ayesha Mohanty[2], Purandar Mandal[2] and Abhiram Dash[2]**
[1]Bidhan Chandra Krishi Viswavidyalaya (BCKVV), Mohanpur, West Bengal
[2]Orissa University of Agriculture & Technology (OUAT), Bhubaneswar, Odisha
***E-Mail**: kaushikpbg@gmail.com

(Received: 20 Jan 2019; Revised: 22 Apr 2019; Accepted: 11 May 2019)

**Abstract**
Twenty six genotypes of pigeonpea were evaluated for 13 agro-morphological characters. Statistical analysis was carried out for estimation of various parameters. The ICPL-87 being shortest genotypes possessed the minimum number of branches, minimum pod weight, lowest 100-seed weight, shortest root length, lowest biological yield per plant and minimum yield per plant. Among all the genotypes, NDA-1 was the tallest genotype. The highest harvest index was showed by NDA-2009-1. Considering the performance of all the genotypes for important characters, including yield, the genotypes; NDA-2009-1, PUSA-992, DA-10-2, MAL-6, ICPL-87 and BRG-2 were promising. Root weight showed very high estimate of genetic advance (85.53%). The value of genetic advance was lowest for root length (20.89%). The residual effect (0.064) indicated that the thirteen characters included in this study explain 93.6 per cent of variation in yield in this population. Plant height, pod weight, root weight and harvest index were positively associated with seed yield simultaneously with positive direct effect. Therefore, direct selection against this character would be effective for seed yield improvement in pigeonpea.

**Key words**
Pigeonpea, Genetic variability, Harvest Index, Genetic Advance, Residual effect.

## Introduction

Pigeonpea, (*Cajanus cajan* L) (2n= 22) belongs to the genus *cajanus* of the sub tribe cajaninae, tribe phaseoleae of the sub-family Papilionoideae, family Fabaceae. The crop ranks fourth in importance as edible legume in the world. Red gram is an important pulse crop in India. India is the largest producer and consumer of red gram in the world. It is a protein rich staple food and consumed in the form of split pulse as Dal. It is likely that pigeonpea evolved by interspecific hybridization of *C. cajanifolia* and *C. scarabaeoides* (Nadimplli *et al.,* 1992) somewhere in the Indian subcontinent (Van der Maesen, 1980). It contains about 22 percent protein, which is almost three times that of cereals. Every Pigeonpea plant is a mini-fertilizer factory as the crop has unique characteristics of restoring and maintaining soil fertility through fixing atmospheric nitrogen in symbiotic association with *rhizobium* bacteria present in the root nodules. Harvest index (HI) is the ratio of economic yield and biological biomass (Donald and Hamblin, 1976) and it is a valuable criterion for an improved plant type, because the morphological frame of the plant must be constructed so that the total dry matter produced is efficiently partitioned between grain and vegetative parts (Jain, 1975). The HI of pigeonpea ranges from 10 to 52 per cent depending upon genotype, environment and agronomic management. The pigeonpea is having narrow genetic base. It is generally grown in poor soils with minimum agronomic inputs. Pigeonpea is sensitive to excess soil moisture (water logging), salinity, alkalinity, and acidity. It is highly susceptible to frost at the time of flowering. Cloudy weather and excessive rainfall at the time of flowering damage the crop to a great extent. Indeterminate pigeonpea variety, generally, face terminal soil moisture stress leading to poor yield. The pod shattering habit of the crop causes considerable yield loss. Thus, the present investigation was carried out with an object to study the variability among the pigeonpea genotypes by considering yield attributing characters, identification of superior genotypes and to study the importance of harvest index and other yield component traits in the yield improvement of pigeonpea.

## Materials and Methods

The field experiment on genetic variability and harvest index of pigeonpea was conducted at the RRS (NAZ), at Gayeshpur, Nadia, West Bengal. The material consisted of 26 pigeonpea genotypes collected from pigeonpea co-ordinate unit, ICAR, (IIPR, Kanpur). The seeds of each genotype were sown during the *kharif* season *i.e.*First week of July with a plot size of 3.5m x 2.75m in three replications following RBD. Plant to plant spacing was 15 cm whereas row to row spacing being 70 cm. The soil is typically Gangetic alluvial soil (Entisol) having sandy soil loam texture with good drainage facilities. The pH level of soil is around 7.2 having 0.059% of total nitrogen, 51.98kg/ha of available $P_2O_5$, 207.48 kg/ha of $K_2O$. The land was brought to a fine-tilth before sowing after repeated ploughing. The doses of fertilizers N: $P_2O_5$: $K_2O$ @ 30:50:30 kg/ha was applied. 2/3$^{rd}$ of the amount of N and the entire amount of $K_2O$ and $P_2O_5$were applied as the basal dose, at the time of final land preparation. Other 1/3$^{rd}$of N was applied as top dressing after 30 days of sowing. Irrigation was given as and when required. Intercultural operation like weeding and thinning were done in time. Regular prophylactic measures were taken to minimize insect and pest attack. Observations on plant height(cm), number of primary branches per plant, pod length(cm), number of seeds per pod, pod weight(g), 100-seed weight(g), root length(cm), root weight(g), days to 50% flowering, days to maturity, biological yield per plant (g), harvest index and seed yield per plant(g) were recorded. Five plants were selected randomly from each plot and the biometrics observations were recorded. The mean value of each character was computed for each entry in each replication and then used for statistical analysis. The data was analysed by electronic computer following appropriate statistical programme.

**Results and Discussion**

The analysis of variance of 26 genotypes with respect to 13 quantitative characters is presented in Table1. The mean sums of squares due to genotypes for all the above characters were highly significant which indicated sufficient genetic variability among the experimental materials.

The mean performance of 26 genotypes for 13 quantitative characters is given in the Table 3. Plant height varied from 63.03 to 152.34 cm with a grand mean of 124.39 cm. The tallest genotype was NDA-1 followed by KA-09-02, KBA-27-1 and the shortest genotype being ICPL-87. Number of primary branches per plant ranged from 7.53 to 15.23 with a mean value of 10.84. The genotype ICPL-87 possessed the minimum number of branches per plant and the genotype BAHAR B/S possessed the maximum number of branches followed by the genotype KBA-40-5, KA-09-02. Pod length ranged from 3.64 to 7.87cm with a mean value of 5.09cm. The genotype BRG-2 was found to have longest pod followed by BAHAR B/S, ASHA and the genotype PUSA-991 was found to have shortest pod. Number of seeds per pod ranged from 2.73 to 5.13 and the grand mean was 3.82. The genotypes PUSA-991 showed lowest number of seeds per pod and the highest number of seeds per pod was shown by BAHAR B/S followed by the genotype BRG-2, ASHA. The range of variability observed for pod weight was 13.73 to 92.97g with a mean value of 50.68g. Among the genotypes, minimum pod weight was found in case of ICPL-87 and maximum pod weight was found in case of PUSA-992 followed by the genotype NDA-1, NDA-2009-1. The lowest 100-seed weight was observed 4.65g in ICPL-87 and the highest was 13.68g in IPA-7-6 followed by ASHA, BRG-2 with a grand mean of 9.95g. Root length varied from 19.51 to 38.97cm with a grand mean of 28.37cm. The genotype ICPL-87 possessed shortest root length whereas the KBA-40-5 possessed longest root length followed by KBA-27-1, MAL-6. The lowest root weight was observed 21.11g in BRG-2 and the highest was 94.80g in KBA-40-5 followed by KA-09-02, PUSA-992 with a grand mean of 43.20g. Days to 50% flowering ranged from 87 to 163 days and the grand mean was 117.94 days. The genotype PUSA-991 and IPA-7-6 showed minimum duration and maximum duration for 50% flowering, respectively. The genotype PUSA-991 registered minimum duration for 50% flowering followed by UPAS-120, PUSA-992. Days to maturity varied from 130 to 204 days with a grand mean of 165.31 days. The genotype PUSA-991 was found to have shortest duration followed by UPAS-120, PUSA-992 and the genotype KBA-40-5 was found to have longest duration for crop maturity. The range of variability observed in biological yield was 76.78g in ICPL-87 to 604.53g in KBA-40-5 with the grand mean of 296.67g. The harvest index being a very important character was greatly influenced by the other characters contributing in the ratio of economic yield to biological yield per plant. The range observed was 6.04 for IPA-7-6 being the minimum and 24.39 for NDA-2009-1 being the maximum with a grand mean of 11.25. The genotypes followed NDA-2009-1 were PUSA-992, DA-10-2, MAL-6, ICPL-87 and BRG-2. Yield per plant is the decisive factor in the experiment conducted and thus is the most important character. The range observed was 10.01g for ICPL-87 being the minimum to 57.07g for NDA-2009-1being the maximum with a mean value of 31.77g. The genotypes followed NDA-2009-1 were ASHA, PUSA-992, NDA-1, KA-09-02 and KBA-40-5.Considering the performance of the genotypes for important characters, including yield, the genotypes NDA-2009-1, PUSA-992,DA-10-2, MAL-6, ICPL-87 and BRG-2 were promising.

The estimates of genotypic coefficient of variation (Table 2) ranged from 11.10% in days to maturity to 42.17% in root weight, whereas for phenotypic coefficient of variation it was 11.92% in days to maturity to 42.84% in root weight. The estimates of genotypic and phenotypic coefficient of variations (GCV and PCV) were high (>20%) in case of pod weight, root weight, biological yield per plant, harvest index and seed yield per plant. Moderate (10-20%) genotypic coefficient of variations and phenotypic coefficient of variations were exhibited by plant height, pod length, number of seeds per pod, 100-seed weight, root length, days to 50% flowering and days to maturity. Number of primary branches per plant showed moderate GCV but high PCV. There were no any character showing low GCV and PCV (0-10%).

A wide spectrum of variation was noticed among the genotypes against all the character studied. This would offer a good scope of selection for evolving promising desirable types. In general, the magnitude of PCV was higher than the corresponding GCV for all the characters indicating the importance of environment on the expression of these characters. The estimates of PCV and GCV values for number of primary branches per plant and root length showed higher differences, which indicate higher role of environmental factors influencing the expression of these characters under study. Very low differences between GCV and PCV values were observed for plant height, pod length, number of seeds per pod, pod weight, 100-seed weight, root weight, days to 50% flowering, days to maturity, biological yield per plant, harvest index and yields per plant indicating low sensitivity to environment and consequently greater role of genetic factors influencing the expression of these characters. Among all the characters, root length was highly influenced by environment. The estimates of heritability in broad sense (Table 2) were very high (>60%) for plant height, number of primary branches per plant, pod length, number of seeds per pod, pod weight, 100-seed weight, root weight, days to 50% flowering, days to maturity, biological yield per plant, harvest index and yields per plant. Moderate heritability (30-60%) estimates was recorded in root length. There were no any character showing low genetic heritability (<30%). Among all the characters, highest heritability was showed by pod length (99.26%) and lowest by root length (58.70%). Similar results have been reported by Patel *et al*., 1998 and Bhadru, 2008. The estimates of genetic advance (Table 2) as per cent of mean were high (>20%) for all the characters including plant height, number of primary branches per plant, pod length, number of seeds per pod, pod weight, 100-seedweight, root length, root weight, days to 50% flowering, days to maturity, biological yieldper plant, harvest index and yield per plant. Root weight showed very high estimate of genetic advance (85.53%). The value of genetic advance was lowest for root length (20.89%). According to Johnson *et al.* (1955) and Lerner (1958) heritability used in conjunction with genetic advance provides better information for selecting the best individuals than the heritability alone. High to moderate estimates of heritability accompanied with high genetic advance for all characters studied indicates the predominance of additive gene action for the expression of these characters (Johnson *et al.*, 1955). Hence, selection for the above characters would be effective in this population.

The results of phenotypic and genotypic coefficient of variability, heritability and genetic advance revealed that improvement through selection for all the characters studied would be effective in this population except root length. In the present investigation, genotypic and phenotypic correlation coefficients among 13 quantitative characters were estimated and studied to reveal how yield is influenced by its component characters. The estimates of genotypic and phenotypic correlation coefficients have been presented (Table 4 and 5, respectively). In general, the genotypic and phenotypic correlations showed similar trend but genotypic correlations were higher in magnitudes than corresponding phenotypic correlations in most of the cases. Very close values of genotypic and phenotypic correlations were also observed between some character combinations, which might be due to reduction in error (environmental) variance to minor proportions as reported by Dewey and Lu (1959). Wide difference between genotypic and phenotypic correlations between two characters is due to dual nature of phenotypic correlation, which is determined by genotypic and environmental correlations and heritability of the characters (Falconer, 1981). Yield per plant was found to be positively and significantly correlated with plant height, number of primary branches per plant, pod weight, root weight, biological yield per plant and harvest index at both genotypic and phenotypic levels indicating the importance of these characters for yield improvement. While, selecting characters having direct bearing on yield, their associations with other characters are to be considered simultaneously as this will indirectly affect yield. Positive and significant correlations at both phenotypic and genotypic levels were found in case of plant height with pod weight, root length, root weight, biological yield per plant and seed yield per plant; number of primary branches per plant with pod length, number of seeds per pod, root weight, biological yield per plant and seed yield per plant; pod length with number of seeds per pod; pod weight with root weight, biological yield per plant and seed yield per plant; root length with root weight and biological yield per plant; root weight with days to maturity, biological yield per plant and seed yield per plant; days to 50%

flowering with days to maturity and biological yield per plant; days to maturity with biological yield per plant; biological yield per plant with seed yield per plant; and finally harvest index with seed yield per plant. Significant negative correlations in this experiment were observed for biological yield per plant with harvest index at phenotypic level and negative correlation at genotypic level indicating negative influence of this character in increasing harvest index. Pod length and number of seeds per pod showed negative correlation with majority of the characters at both phenotypic and genotypic levels. Similar trend was reported by Prasad *et al.* (2013), Linge *et al.* (2010 and Sodavadiya *et al.* (2009) in pigeonpea. Such type of negative association may arise primarily from developmentally induced relationship. The developing structures of the plant compete for a common factor, possibly limited nutrient supply and if one structure is more favoured than the other for any reason, a negative correlation may arise between them. Component compensation of parents allows an opportunity to have reasonable compromise and balance between one or two components resulting high yield. The optimal genetic level for each component would differ depending on the type of the environment encountered. Pleiotropy and / or linkage may also be the genetic reasons for this type of negative association where association might occur between desirable and undesirable characters. The pleiotropic genes that affect both characters in the desired direction will be strongly acted upon by selecting and rapidly brought towards fixation. The results of correlation coefficient implied that harvest index, plant height, number of primary branches per plant, pod length, pod weight, root weight and biological yield per plant may be considered for selection for yield improvement in the population of pigeonpea under study. Path coefficient analysis is to be done to estimate the relationship of various characters and their effects on yield. The residual effect (0.064) indicated that the thirteen characters included in this study explain 93.6 per cent of variation in yield in this population (Table 6). The results of path analysis indicated that some other causal variables should have been included. From the analysis of path coefficient, positive direct effect on yield per plant was contributed by all the characters except number of primary branches per plant and root length. Number of primary branches per plant and root length showed negative direct effect on yield.

The indirect effect of plant height on yield via pod weight, 100-seed weight, root length, root weight, days to 50% flowering, days to maturity and biological yield per plant showed positive association but effect on yield via number of primary branches per plant, pod length, number of seeds per pod and harvest index showed negative association. Similarly, number of primary branches per plant showed positive indirect association with all the characters studied except harvest index. Hence, from the analysis of path coefficient it can be concluded that these characters showing positive direct effect on yield should be considered, while conducting breeding programme for the selection of superior pigeonpea genotypes. Pod length showed positive indirect effect on yield via number of seeds per pod, 100-seed weight, days to 50% flowering and days to maturity and the opposite via plant height, number of primary branches per plant, pod weight, root length, root weight, biological yield per plant and harvest index. Number of seeds per pod had positive indirect association on yield with pod length, 100-seed weight and biological yield per plant. It showed negative relation for yield with plant height, number of primary branches per plant, pod weight, root length, root weight, days to 50% flowering, days to maturity and harvest index.

Pod weight had positive indirect effect through plant height, 100-seed weight, root weight, days to 50% flowering, days to maturity, biological yield per plant and harvest index. It showed negative effect via all of the other remaining characters. Weight of 100-seed had indirect positive effect on yield via plant height, number of seeds per pod, pod length, pod weight, days to 50% flowering, days to maturity and harvest index and exhibited negative relation on yield via number of primary branches per plant, root length, root weight and biological yield. Root length showed indirect positive effect on yield through all the characters studied except number of primary branches per plant and harvest index. Root weight showed indirect positive effect on yield via plant height, pod weight, days to 50% flowering, days to maturity and biological yield per plant. It showed negative effects via all of the other remaining characters. Days to 50% flowering had indirect positive effect on yield via plant height, pod length, pod weight, 100-seed weight, root weight, days to maturity and biological yield per plant and exhibited negative relation on yield via number of primary branches per plant, number of seeds per pod, root length and harvest index.

Days to maturity showed indirect positive effect on yield via plant height, pod length, pod weight, 100-seed weight, root weight, days to 50% flowering and biological yield per plant. It showed negative effects on yield via number of primary branches per plant, number of seeds per pod, root length and harvest index. Biological yield per plant showed indirect positive effect on yield through plant height, number of seeds per pod, pod weight, root weight, days to 50% flowering and days to maturity. It had a strong negative effect on yield through number of primary branches per plant, pod length, 100-seed weight, root length and harvest index. Harvest index showed to be a very important character having indirect effect on yield via number of primary branches per plant, pod weight, 100-seed weight and root length. On the other hand, it showed negative association with yield through plant height, pod length, number of seeds per pod, root weight, days to 50% flowering, days to maturity and biological yield per plant. Number of primary branch per planthad positive association on yield through important characters like; plant height, number of seeds per pod, pod length and 100-seeds weight and was effective, hence, emphasis should be given on causal variables plant height, number of seeds per pod, pod length and 100-seeds weight at the time of selection of the high yielding genotypes. Number of seeds per pod, pod weight, 100-seed weight and harvest index showed the positive indirect effect via other characters. Similar findings were also reported by Devi *et al*., 2012, Mittal *et al*., 2010 and Kanade *et al*., 2010. So, it is easy to infer that a breeder should pay more heed to those characters, while selecting a high yielding variety. Harvest index showed a direct positive association with yield. Thus, it is a valuable character for selection in breeding programme. So, the breeders should take heed of this character for increasing yield. Plant height, pod weight, root weight and harvest index were positively associated with seed yield simultaneously with positive direct effect. Therefore, direct selection against this character would be effective for yield improvement in pigeonpea.

Pod length and number of seeds per pod was negatively associated with yield but their direct effects were positive and high. Under these circumstances, a restricted simultaneous selection model is to be followed, *i.e*. restrictions are to be imposed to nullify the undesirable effects in order to make use of the direct effect (Singh and Kakar, 1977). Number of primary branches per plant showed negative correlation coefficient with harvest index and had negative indirect effect also. Therefore, the correlation explained the true relationship *i.e.* harvest index was inversely related with number of primary branches per plant. Thus, it suggested selection for less spreading type of plant would be effective for harvest index improvement in pigeonpea. In case of number of primary branches per plant and root length, the correlation coefficients were positive but the direct effects were negative. So, the indirect effects seem to be cause of correlation. In such situations, the indirect causal factors should be considered simultaneously for selection.

## References

Bhadru, D. 2008. Genetic variability, heritability and genetic advance in pigeonpea [Cajanus cajan (L.) Millsp.]. *Abs. Res. Crops.*,**9(3):** 661-662.

Devi, S. R., Prasanthi, L., Reddy, K. H. P. and Reddy, B. V. B.2012. Studies on interrelationships of yield and its attributes and path analysis in pigeonpea [*Cajanuscajan* (L.) Millsp.].*Legume Res.*,**35:** 207- 213.

Dewey, O.R. and Lu, K.H. 1959. A correlation and path coefficient analysis of components of crested wheatgrass seed production. *J. Agron.***57:** 515-518.

Donald, C.M. and Hamblin, J. 1976. The biological yield and harvest index of cereals as agronomic and plant breeding criteria. *Adv. Agren.*, **28**: 361-405.

Falconer, D.S.1981. *Introduction to Quantitative Genetics*, Longman Scientific and Technical, England. pp:438.

Jain, H. K. 1975. Breeding for yield and other attribution in grain legumes. *Indian J. Genet.***35**: 169-187.

Johnson, H.W. Robinson, H.F. and Comstock, R.E. 1955. Estimates of genetic and environmental variability in soyabean. *Agron. J.,***47**: 314-318.

Kanade, P. B., Harer, P. N. and Kshirsagar, A. N. 2010. Correlation and path analysis studies in pigeonpea [*Cajanus cajan* (L.) Millsp.]. *J. Maharashtra Agric. Univ*.,**35:** 494-496.

Lerner, I.M. 1958. *The genetic basis of selection*. John Wiley, New York.

Linge, S. S., Kalpande, H. V., Sawargaonlar, S. L., Hudge, B. V. and Thanki, H. P. 2010. Study of genetic variability and correlation ininterspecific derivatives of pigeonpea (*Cajanus cajan* (L.) Millsp.)*Electron. j. plant breed*.,**1** (4):929-935.

Mittal, V. P. Singh, P. and Brar, K. S. 2010. Character association and path coefficient analysis for yield components in pigeonpea. *Madras Agric. J.*,**97**: 319-20.

Nadimpalli, B.G., Jarret, R.L., Pathak, S.C., Kochert, G. 1992. Phylogenetic relationships of pigeonpea (*Cajanus cajan*) based on nuclear restriction fragment length polymorphisms. *Genome*, **36**: 216-223.

Patel, K. N. and Patel, D. R. 1998. Studies on genetic variability in pigeon pea. *Intern. chickpea and pigeon pea newsletter.,***5:** 28-30.

Prasad, Y., Kumar, K. and Mishra, S.B. 2013. Studies on genetic parameters and inter-relationships among yield and yield contributing traits in Pigeonpea [*Cajanus cajan* (L.) Millsp.]. *The bioscan***.,8**(1): 207-211.

Singh, R.K. and Kakar, S.N. 1977. Control on individual trait means during index selection. Proc. Third congr. *SABRAO (Canberra),***3**(d): 22-25

Sodavadiya, M. S., Pithia, J. J., Savaliya, A. G., Pansuriya and Korat, V. K. 2009**.** Studies on characters association and path analysis forseed yield and its components in pigeonpea *(Cajanus cajan* (L)Millsp*).Legume Res.* **32** (3):203-205.

Van der Maesen, L.J.G. 1980. *India is the native home of the pigeonpea*. In: Arends, J.C. Boelema, G. de Groot, C.T. Leeuwenberg, A.J.M. (eds). Libergratulatorius in honorem H.C.D. de Wit. Landbouwhogeschool Miscellaneous Paper No.19. Wageningen. The Netherlands: Veenman H and Zonen BV, pp. 257-262.

**Table 1. Analysis of variance for thirteen characters in pigeonpea**

| Source | d. f. | Mean Sum of Squares | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Plant height (cm) | No. of primary branches /plant | Pod length (cm) | No. of seeds/ pod | Pod weight (g) | 100-seed weight (g) | Root length (cm) | Root weight (g) | Days to 50% flowering | Days to maturity | Biological yield/plant (g) | Harvest index | Seed yield/ plant (g) |
| **Replications** | 2 | 71.07 | 10.67 | 0.0053 | 0.0246 | 32.02 | 0.10 | 1.9755 | 16.93 | 23.19 | 1.94 | 605.88 | 0.465 | 5.07 |
| **Genotypes** | 25 | 1280.11** | 11.47** | 2.62** | 0.88 | 1243.19** | 10.24** | 52.23** | 1006.44** | 1210.18** | 1062.10** | 34618.84** | 41.426** | 382.09** |
| **Error** | 50 | 48.31 | 1.36 | 0.0065 | 0.03 | 11.8036 | 0.0873 | 9.92 | 10.54 | 22.15 | 51.52 | 1414.81 | 0.461 | 5.71 |

*, ** Significant at P=0.05 and 0.01, respectively. d. f. = degree of freedom

**Table 2. Phenotypic and genotypic coefficient of variability, heritability and genetic advance for thirteen characters of pigeonpea**

| Characters | GCV(%) | PCV(%) | Heritability (%) | GA (%) of Mean |
|---|---|---|---|---|
| Plant height (cm) | 16.29 | 17.22 | 89.47 | 31.74 |
| No. of primary branches/plant | 16.93 | 20.06 | 71.24 | 29.44 |
| Pod length (cm) | 18.35 | 18.42 | 99.26 | 37.68 |
| No. of seeds/pod | 13.96 | 14.70 | 90.19 | 27.32 |
| Pod weight (g) | 39.97 | 40.54 | 97.20 | 81.18 |
| 100-seed weight (g) | 18.49 | 18.72 | 97.49 | 37.60 |
| Root length (cm) | 13.23 | 17.27 | 58.70 | 20.89 |
| Root weight (g) | 42.17 | 42.84 | 96.92 | 85.53 |
| Days to 50% flowering | 16.87 | 17.33 | 94.70 | 33.82 |
| Days to maturity | 11.10 | 11.92 | 86.73 | 21.30 |
| Biological yield/plant (g) | 35.22 | 37.43 | 88.53 | 68.26 |
| Harvest index | 32.86 | 33.41 | 96.73 | 66.58 |
| Seed yield/plant (g) | 35.26 | 36.05 | 95.64 | 71.03 |

Electronic Journal of Plant Breeding, 10 (3): 1223 - 1233(Sep2019) DOI: 10.5958/0975-928X.2019.00155.8
ISSN 0975-928X

**Table 3. Mean values and CD of thirteen characters of pigeonpea**

| Genotypes | Plant height (cm) | No. of primary branches/ plant | Pod length (cm) | No. of seeds/ pod | Pod weight (g) | 100-seed weight(g) | Root length (cm) | Root weight (g) | Days to 50% flowering | Days to maturity | Biological yield/plant (g) | Harvest index | Seed yield/ plant (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASHA | 134.70 | 13.20 | 5.93 | 4.53 | 73.28 | 8.26 | 29.78 | 57.72 | 118.33 | 166.67 | 471.45 | 11.73 | 55.28 |
| BAHAR | 135.12 | 8.60 | 4.09 | 3.47 | 49.83 | 12.65 | 25.17 | 23.39 | 138.00 | 173.00 | 219.94 | 11.99 | 26.36 |
| BAHAR B/S | 108.54 | **15.23** | 7.52 | **5.13** | 50.15 | 11.68 | 27.76 | 24.33 | 109.67 | 154.67 | 281.80 | 9.46 | 26.42 |
| BON-2 | 126.75 | 8.07 | 5.31 | 4.27 | 24.31 | 9.93 | 30.85 | 22.30 | 99.33 | 149.67 | 210.70 | 9.28 | 19.55 |
| BRG-2 | 90.59 | 11.27 | **7.87** | 4.93 | 28.65 | 11.79 | 27.65 | **21.11** | 101.00 | 152.00 | 171.39 | 12.91 | 21.89 |
| CDRG-9701 | 117.79 | 12.20 | 5.05 | 4.07 | 34.48 | 10.31 | 24.09 | 36.57 | 97.67 | 149.67 | 282.10 | 9.25 | 25.86 |
| DA-10-1 | 137.83 | 10.33 | 4.64 | 3.27 | 62.06 | 9.83 | 31.87 | 48.01 | 112.00 | 145.00 | 261.49 | 12.02 | 31.33 |
| DA-10-2 | 112.89 | 9.60 | 4.37 | 3.27 | 68.76 | 10.07 | 26.01 | 32.19 | 123.00 | 177.67 | 257.81 | 13.92 | 35.63 |
| DA-10-3 | 108.83 | 9.33 | 4.69 | 3.20 | 39.54 | 10.58 | 26.27 | 47.38 | 127.00 | 181.00 | 239.62 | 11.85 | 28.37 |
| ICPL-87 | **63.03** | **7.53** | 5.19 | 3.60 | **13.73** | **4.65** | **19.51** | 22.38 | 91.67 | 142.67 | **76.78** | 13.08 | **10.01** |
| IPA-7-6 | 117.80 | 10.53 | 5.51 | 3.80 | 23.27 | **13.68** | 30.23 | 37.50 | **163.00** | **204.00** | 295.16 | **6.04** | 17.77 |
| KA-09-02 | 152.22 | 13.67 | 5.47 | 4.07 | 57.72 | 9.04 | 29.43 | 75.64 | 127.00 | 178.00 | 333.70 | 11.92 | 39.57 |
| KA-10-1 | 141.98 | 12.20 | 3.90 | 3.73 | 50.39 | 9.95 | 31.67 | 61.40 | 120.67 | 182.33 | 287.60 | 12.75 | 36.37 |
| KA-10-108 | 147.76 | 10.33 | 4.32 | 3.27 | 75.79 | 10.63 | 26.42 | 52.01 | 123.67 | 176.33 | 462.15 | 7.99 | 36.91 |
| KBA-27-1 | 151.68 | 10.53 | 5.07 | 3.67 | 66.17 | 8.85 | 35.24 | 46.56 | 128.00 | 175.33 | 347.44 | 9.04 | 31.28 |
| KBA-40-5 | 149.51 | 14.53 | 5.59 | 4.40 | 57.59 | 7.35 | **38.97** | **94.80** | 149.67 | 191.00 | **604.53** | 6.59 | 39.46 |
| MA-6 | 131.75 | 11.33 | 4.64 | 3.40 | 43.71 | 10.78 | 23.79 | 41.37 | 123.00 | 172.33 | 313.30 | 9.82 | 30.75 |
| MAL-6 | 125.23 | 8.93 | 5.27 | 4.07 | 51.60 | 11.15 | 32.79 | 34.38 | 138.00 | 173.00 | 278.72 | 13.47 | 37.43 |
| MARUTI | 111.47 | 9.80 | 4.73 | 3.80 | 28.26 | 9.04 | 24.79 | 29.27 | 104.67 | 155.67 | 185.29 | 10.85 | 19.92 |
| NDA-1 | **152.34** | 12.27 | 4.99 | 3.53 | 81.82 | 8.84 | 31.29 | 54.15 | 140.33 | 180.00 | 393.18 | 10.55 | 41.36 |
| NDA-7-11 | 110.96 | 10.27 | 5.15 | 3.80 | 49.28 | 11.19 | 26.65 | 50.80 | 140.33 | 181.00 | 366.33 | 9.78 | 35.78 |
| NDA-2009-1 | 105.57 | 12.20 | 5.17 | 3.80 | 76.37 | 11.62 | 24.93 | 35.48 | 123.00 | 175.33 | 234.02 | **24.39** | **57.07** |
| PUSA-9 | 129.11 | 11.67 | 5.00 | 4.07 | 39.27 | 10.65 | 29.99 | 54.51 | 101.00 | 161.33 | 348.82 | 8.23 | 28.67 |
| PUSA-991 | 121.67 | 8.53 | **3.64** | **2.73** | 52.54 | 9.51 | 26.09 | 26.53 | **87.00** | **130.00** | 320.14 | 8.35 | 26.34 |
| PUSA-992 | 130.29 | 9.80 | 4.50 | 3.47 | **92.97** | 9.37 | 32.28 | 66.11 | 90.00 | 137.67 | 268.56 | 18.10 | 48.47 |
| UPAS-120 | 118.73 | 9.93 | 4.69 | 4.07 | 25.78 | 7.23 | 24.10 | 27.28 | 89.33 | 132.67 | 201.39 | 9.00 | 18.05 |
| **Mean** | 124.39 | 10.84 | 5.09 | 3.82 | 50.68 | 9.95 | 28.37 | 43.20 | 117.94 | 165.31 | 296.67 | 11.25 | 31.77 |
| **CD at 5%** | 11.40 | 1.91 | 0.13 | 0.29 | 5.64 | 0.49 | 5.17 | 5.33 | 7.72 | 11.73 | 61.69 | 1.11 | 3.92 |

Electronic Journal of Plant Breeding, 10 (3): 1223 - 1233(Sep2019) DOI: 10.5958/0975-928X.2019.00155.8
ISSN 0975-928X

**Table 4. Genotypic correlation coefficients of thirteen characters in pigeonpea**

| Characters | Plant height (cm) | No. of primary branches/ plant | Pod length (cm) | No. of seeds/ pod | Pod weight (g) | 100-seed weight (g) | Root length (cm) | Root weight (g) | Days to 50% flowering | Days to maturity | Biological yield/plant (g) | Harvest index | Seed yield/ plant (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plant height (cm)** | 1.000 | 0.364 | -0.318 | -0.139 | 0.576** | 0.061 | 0.738** | 0.650** | 0.398* | 0.365 | 0.716** | -0.278 | 0.467* |
| **No. of primary branches/plant** | | 1.000 | 0.525** | 0.617** | 0.314 | 0.065 | 0.418* | 0.559** | 0.280 | 0.376 | 0.582** | -0.061 | 0.464* |
| **Pod length (cm)** | | | 1.000 | 0.883** | -0.204 | 0.147 | 0.143 | -0.121 | 0.028 | 0.015 | -0.019 | -0.033 | -0.072 |
| **No. of seeds/pod** | | | | 1.000 | -0.251 | 0.057 | 0.257 | -0.005 | -0.025 | -0.002 | 0.069 | -0.087 | -0.025 |
| **Pod weight (g)** | | | | | 1.000 | 0.034 | 0.444* | 0.508** | 0.216 | 0.193 | 0.526** | 0.407* | 0.868* |
| **100-seed weight (g)** | | | | | | 1.000 | 0.028 | -0.234 | 0.400* | 0.387 | -0.031 | 0.047 | 0.069 |
| **Root length (cm)** | | | | | | | 1.000 | 0.707** | 0.467* | 0.400* | 0.666** | -0.196 | 0.409* |
| **Root weight (g)** | | | | | | | | 1.000 | 0.385 | 0.450* | 0.762** | -0.077 | 0.585* |
| **Days to 50% flowering** | | | | | | | | | 1.000 | 0.939** | 0.501** | -0.161 | 0.286 |
| **Days to maturity** | | | | | | | | | | 1.000 | 0.506** | -0.114 | 0.323 |
| **Biological yield/plant (g)** | | | | | | | | | | | 1.000 | -0.378 | 0.547** |
| **Harvest index** | | | | | | | | | | | | 1.000 | 0.536** |
| **Seed yield/plant (g)** | | | | | | | | | | | | | 1.000 |

***, ** Significant at P=0.05 and 0.01, respectively**

Electronic Journal of Plant Breeding, 10 (3): 1223 - 1233(Sep2019) DOI: 10.5958/0975-928X.2019.00155.8
ISSN 0975-928X

**Table 5. Phenotypic correlation coefficients of thirteen characters in pigeonpea**

| Characters | Plant height (cm) | No. of primary branches/plant | Pod length (cm) | No. of seeds/ pod | Pod weight (cm) | 100-seed weight (g) | Root length (cm) | Root weight (g) | Days to 50% flowering | Days to maturity | Biological yield/plant (g) | Harvest index | Seed yield/ plant (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plant height (cm)** | 1.000 | 0.342 | -0.305 | -0.147 | 0.548** | 0.063 | 0.565** | 0.626** | 0.366 | 0.317 | 0.673** | -0.269 | 0.460* |
| **No. of primary branches/plant** | | 1.000 | 0.433* | 0.509** | 0.295 | 0.061 | 0.284 | 0.508** | 0.213 | 0.238 | 0.550** | -0.085 | 0.431* |
| **Pod length (cm)** | | | 1.000 | 0.842** | -0.200 | 0.146 | 0.087 | -0.120 | 0.028 | 0.020 | -0.022 | -0.029 | -0.071 |
| **No. of seeds/pod** | | | | 1.000 | -0.231 | 0.053 | 0.154 | -0.012 | -0.016 | 0.002 | 0.072 | -0.084 | -0.014 |
| **Pod weight (g)** | | | | | 1.000 | 0.034 | 0.356 | 0.510** | 0.206 | 0.171 | 0.529** | 0.382 | 0.868** |
| **100-seed weight (g)** | | | | | | 1.000 | 0.018 | -0.223 | 0.382 | 0.360 | -0.028 | 0.041 | 0.068 |
| **Root length (cm)** | | | | | | | 1.000 | 0.550** | 0.322 | 0.265 | 0.522** | -0.163 | 0.344 |
| **Root weight (g)** | | | | | | | | 1.000 | 0.368 | 0.405* | 0.748** | -0.093 | 0.587** |
| **Days to 50% flowering** | | | | | | | | | 1.000 | 0.918** | 0.452* | -0.151 | 0.269 |
| **Days to maturity** | | | | | | | | | | 1.000 | 0.411* | -0.093 | 0.284 |
| **Biological yield/plant (g)** | | | | | | | | | | | 1.000 | -0.396* | 0.564** |
| **Harvest index** | | | | | | | | | | | | 1.000 | 0.495* |
| **Seed yield/plant (g)** | | | | | | | | | | | | | 1.000 |

***, ** Significant at P=0.05 and 0.01, respectively.**

Electronic Journal of Plant Breeding, 10 (3): 1223 - 1233(Sep2019) DOI: 10.5958/0975-928X.2019.00155.8
ISSN 0975-928X

**Table 6. Path coefficient (genotypic) analysis showing direct (bold) and indirect effects of yield component traits in pigeonpea**

| Characters | Plant Height (cm) | No. of primary branches/plant | Pod length (cm) | No. of seeds / pod | Pod weight (g) | 100-seed weight (g) | Root length (cm) | Root weight (g) | Days to 50% flowering | Days to maturity | Biological yield/plant (g) | Harvest index | Corre-lation values for seed yield /plant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plant height (cm)** | **0.64826** | -0.33157 | -0.06664 | -0.12230 | 0.34627 | 0.00773 | 0.077348 | 0.51348 | 0.04719 | 0.01517 | 0.33508 | -0.15233 | 0.467 |
| **No. of primary bran./plant** | 0.23591 | **-0.91112** | 0.10996 | 0.54205 | 0.18865 | 0.00828 | 0.43865 | 0.44119 | 0.03321 | 0.01562 | 0.27244 | -0.03331 | 0.464 |
| **Pod length (cm)** | -0.20627 | -0.47840 | **0.20943** | 0.77593 | -0.12280 | 0.01864 | -0.15045 | -0.09521 | 0.00327 | 0.00064 | -0.00902 | -0.01789 | -0.072 |
| **No. of seeds/ pod** | -0.09023 | -0.56209 | 0.18495 | **0.87864** | -0.15119 | 0.00728 | -0.26913 | -0.00422 | -0.00298 | -0.00008 | 0.03231 | -0.04787 | -0.025 |
| **Pod weight (g)** | 0.37318 | -0.28575 | -0.04275 | -0.22084 | **0.60152** | 0.00429 | -0.46616 | 0.40154 | 0.02565 | 0.00802 | 0.24635 | 0.22322 | 0.868 |
| **100-seed weight (g)** | 0.03938 | -0.05935 | 0.03070 | 0.05029 | 0.02031 | **0.12719** | -0.02934 | -0.18453 | 0.04738 | 0.01608 | -0.01442 | 0.02558 | 0.069 |
| **Root length (cm)** | 0.47811 | -0.38109 | 0.03004 | 0.22548 | 0.26737 | 0.00356 | **-1.04874** | 0.55884 | 0.05533 | 0.01664 | 0.31168 | -0.10774 | 0.409 |
| **Root weight (g)** | 0.42138 | -0.50886 | -0.02524 | -0.00469 | 0.30576 | -0.02971 | -0.74193 | **0.78994** | 0.04564 | 0.01870 | 0.35640 | -0.04239 | 0.585 |
| **Days to 50% flowering** | 0.25804 | -0.25524 | 0.00578 | -0.02211 | 0.13013 | 0.05082 | -0.48948 | 0.30409 | **0.11855** | 0.03899 | 0.23449 | -0.08815 | 0.286 |
| **Days to maturity** | 0.23666 | -0.34253 | 0.00324 | -0.00160 | 0.11605 | 0.04921 | -0.41993 | 0.35552 | 0.11127 | **0.04155** | 0.23654 | -0.06276 | 0.323 |
| **Biological yield/plant (g)** | 0.46421 | -0.53047 | -0.00404 | 0.06067 | 0.31668 | -0.00392 | -0.69855 | 0.60166 | 0.05941 | 0.02100 | **0.46793** | -0.20730 | 0.547 |
| **Harvest index** | -0.17991 | 0.05530 | -0.00683 | -0.07663 | 0.24463 | 0.00593 | 0.20586 | -0.06101 | -0.01904 | -0.00475 | -0.17673 | **0.54886** | 0.536** |

Residual Value = 0.064, Diagonal values are direct effects and above and below diagonal values are indirect effects.

INDIAN SOCIETY OF PLANT BREEDERS

ESTD 1995

*https://ejplantbreeding.org*