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# Genetic Variability, Cause, Effect and Relationship Among Yield and its Attributes in Pigeonpea (*Cajanus Cajan* L.Millsp.)

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**An investigation was carried out on variability, correlation and path analysis for ten characters of pigeonpea germplasm lines raised during kharif 2010-11. Days to 50 per cent flowering, days to maturity and plant height showed low coefficient of variation and low genetic advance as percent of mean. Number of secondary branches per plant and number of pods per pant showed high coefficient of variation along with high heritability estimates. Days to 50 per cent flowering, days to maturity, number of primary branches per plant and number of secondary branches per plant showed positive and significant correlation with number of pods per plant both at phenotypic and genotypic levels. Number of primary branches per plant showed positive significant association while, plant height and pod damage percentage showed negative significant association with seed yield. Path analysis revealed that days to 50 per cent flowering, number of primary branches per plant and number of pods per plant exerted positive direct effect on seed yield.**

**Key words**: Pigeonpea, variability, correlation, path analysis

Pigeonpea (*Cajanus cajan* L.) is an important pulse crop cultivated for its premier pulse with manifold uses. Genetic variability is the most important feature of any population and variability present in the population is the pre requiste in response to selection for nay crop improvement programme. Selection of superior variety will be possible only when adequate variability exists in the gene pool. Hence the insight into the magnitude of variability present in the gene pool of a crop species is of at most importance to plant breeder for starting a judicious plant breeding programme. The coefficient of variation expressed in phenotypic and genotypic levels are used to compare the variability observed among different characters. A wide range of variation has been reported for seed yield and seed number and other important components of yield. The heritability estimates aid in determining the relative amount of heritable portion in variation and thus helps the plant breeder in selecting the elite inbreds from a diverse population. Seed yield is a complex and polygenically controlled character and highly influenced by a number of components. Selection based on the component characters has been considered to be more effective as compared to the selection of yield *per se*. Both correlation and path coefficient analysis form a basis for selection and also help in understanding yield components effecting yield improvement through the study of direct and indirect effects. Therefore the present study was undertaken for assessing the extent of genetic variability, heritability and genetic advance in pigeonpea genotypes.

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## Materials and Methods

The material for the present study comprising of obtained sixty eight pigeonpea (*Cajanus cajan* L.Millsp) germplasm lines collected from various parts of Andhra Pradesh were sown in randomized block design at Agricultural Research Station, Tandur during rabi 2010-11. The entries were grown in 5m long two row plots with a spacing of 100 cm between the plants and 20 cm between the rows. Recommended cultural practices were followed to raise a good crop. Under each treatment and each replication, five competitive plants were randomly selected for recording observations for seven metric characters *viz.*, days to 50per cent flowering, days to maturity, plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of pods per plant, test weight (g), seed yield (kg/ha) and wilt (per cent) and pod damage (per cent). Analysis of variance and estimates of genotypic and phenotypic coefficients of variation, broad sense heritability and expected genetic gain were worked out following conventional methods (Falconer, 1964). The genotypic correlations were worked out by using the formula as suggested by Johnson *et al.,* (1955) and path analysis in accordance with Dewey and Lu (1959).

## Results and Discussion

The analysis of variance revealed significant differences for all the ten traits studied (Table 1). The range was of variation was maximum for the characters *viz.,* seed yield (357-986 kg/ha) followed

**Table 1. Genetic parameters for agro morphological traits in pigeonpea**

| Character | Mean sum of squares | Range | Mean ± SE | PCV | GCV | Heritability | GA | GA as per cent of mean |
|---|---|---|---|---|---|---|---|---|
| Days to 50 per cent flowering | 114.98 | 106-136 | 121.47 ± 1.26 | 5.30 | 4.98 | 88.4 | 11.74 | 9.66 |
| Days to maturity | 118.451 | 167-198 | 181.58 ± 1.31 | 3.60 | 3.38 | 87.9 | 11.87 | 6.53 |
| Plant height (cm) | 672.78 | 120-204 | 153.72 ± 7.23 | 11.80 | 8.52 | 52.2 | 19.52 | 12.70 |
| Number of primary branches per plant | 16.35 | 3-14.3 | 7.65 ± 0.35 | 31.20 | 30.14 | 93.3 | 4.59 | 59.96 |
| Number of secondary branches per plant | 34.87 | 2.2-18.40 | 5.10 ± 0.36 | 67.47 | 66.36 | 96.7 | 6.86 | 134.44 |
| Number of pods per plant | 7038.009 | 44-378 | 89.60 ± 7.49 | 55.33 | 53.40 | 93.1 | 95.13 | 106.17 |
| Test weight (g) | 4.416 | 7.63-13.10 | 9.94 ± 0.25 | 12.71 | 11.94 | 88.2 | 2.29 | 23.10 |
| Seed yield (kg/ha) | 30321.056 | 357-986 | 600.13 ± 31.38 | 18.31 | 15.91 | 75.5 | 170.98 | 28.49 |
| Wilt (per cent) | 518.071 | 10.3-64.6 | 31.86 ± 3.06 | 43.43 | 40.10 | 85.2 | 24.30 | 76.27 |
| Pod damage (per cent) | 529.075 | 2.6-62.6 | 22.23 ± 4.55 | 66.37 | 56.10 | 71.4 | 21.71 | 97.67 |

by number of pods per plant (44-378) and plant height (120-204 cm), while, it was lowest in the case of test weight (7.63 to 13.1 g) (Table 1). In general, PCV values were marginally higher than the GCV values.

**Table 2. Correlations among the different agro morphological traits in pigeonpea**

| Character | Days to 50per cent flowering | Days to maturity | Plant height (cm) | Number of primary branches per plant | Number of secondary branches per plant | Number of pods per plant | Test weight (g) | Wilt (per cent) | Pod damage (per cent) | Seed yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|---|---|
| Days to 50per cent flowering | 1.0000 | 0.9920** (0.9770**) | -0.1034 (-0.0892) | 0.0394 (0.0851) | 0.1040 (0.0963) | 0.1656* (0.1572*) | 0.0026 (0.0073) | 0.0866 (0.1005) | -0.0477 (-0.0178) | 0.0003 (-0.0030) |
| Days to maturity | | 1.0000 | -0.1534* (-0.1145) | 0.1217 (0.1085) | 0.1410* (0.1300) | 0.2033* (0.1904**) | 0.0013 (0.0078) | 0.0837 (0.1004) | -0.0588 (-0.0249) | -0.0046 (0.0026) |
| Plant height (cm) | | | 1.0000 | -0.0492 (-0.0447) | -0.0096 (0.0166) | 0.0376 (0.0387) | -0.0451 (-0.0430) | 0.0042 (-0.0052) | -0.2219* (-0.0944) | -0.2695* (-0.1390*) |
| Number of primary branches per plant | | | | 1.0000 | 0.1873* (0.1701*) | 0.4248** (0.3869**) | 0.0279 (0.0193) | 0.0831 (0.0867) | 0.0144 (0.0317) | 0.2236 (0.1795*) |
| Number of secondary branches per plant | | | | | 1.0000 | 0.5714** (0.5393**) | -0.2491* (-0.2215**) | 0.1235 (0.1179) | -0.1191 (-0.0974) | -0.0283 (-0.0214) |
| Number of pods per plant | | | | | | 1.0000 | -0.1417* (-0.1302) | 0.0126 (0.0191) | 0.0290 (0.0480) | 0.1033 (0.0826) |
| Test weight (g) | | | | | | | 1.0000 | 0.0847 (0.0753) | -0.1332 (-0.0737) | -0.1721 (-0.1396*) |
| Wilt (per cent) | | | | | | | | 1.0000 | -0.2122* (-0.1684*) | -0.0584 (-0.0720) |
| Pod damage (per cent) | | | | | | | | | 1.0000 | -0.1492* (-0.0709) |
| Seed yield (kg/ha) | | | | | | | | | | 1.0000 |

Figures in parentheses are genotypic estimates

The characters studied in the present investigation showed moderate to low PCV and GCV values. The magnitude of variation was high for the characters *viz.*, secondary branches per plant, pod damage (per cent), number of pods per plant, wilt (per cent), seed yield (kg/ha) and number of primary branches per plant. These results are in accordance with the earlier reports of Dahiya and Singh (1994). Moderate levels of GCV and PCV were obtained for the trait test weight. Similar results were reported by Paul *et al., (*1996) However, low values were recorded for the characters, days to 50 per cent flowering, days to maturity and plant height. These results were in agreement with the reports of Aher *et al.,(*1998).

**Table 3. Path analysis among the different agro morphological traits in pigeonpea**

| Character | Days to 50per cent flowering | Days to maturity | Plant height (cm) | Number of primary branches per plant | Number of secondary branches per plant | Number of pods per plant | Test weight (g) | Wilt (per cent) | Pod damage (per cent) | Seed yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|---|---|
| Days to 50per cent flowering | 2.0474 | 2.0311 | -0.2117 | 0.1912 | 0.2130 | 0.3391 | 0.0053 | 0.1772 | -0.0976 | 0.0003 |
| Days to maturity | -2.1197 | -2.1367 | 0.3278 | -0.2601 | -0.3012 | -0.4343 | -0.0029 | -0.1788 | 0.1256 | -0.0046 |
| Plant height (cm) | 0.0410 | 0.0608 | -0.3962 | 0.0195 | 0.0038 | -0.0149 | 0.0179 | -0.0016 | 0.0879 | -0.2695* |
| Number of primary branches per plant | 0.0225 | 0.0293 | -0.0119 | 0.2410 | 0.0451 | 0.1024 | 0.0067 | 0.0200 | 0.0035 | 0.2236* |
| Number of secondary branches per plant | -0.0132 | -0.0179 | 0.0012 | -0.0238 | -0.1270 | -0.0725 | 0.316 | -0.0157 | 0.0151 | -0.0283 |
| Number of pods per plant | 0.0258 | 0.0316 | 0.0058 | 0.0661 | 0.0889 | 0.1555 | -0.0220 | 0.0020 | 0.0045 | 0.1033 |
| Test weight (g) | -0.0005 | -0.0003 | 0.0094 | -0.0058 | 0.0519 | 0.0295 | -0.2083 | -0.0176 | 0.0277 | -0.1721 |
| Wilt (per cent) | -0.0043 | -0.0042 | -0.0002 | -0.0041 | -0.0062 | -0.0006 | -0.0042 | -0.0498 | 0.0106 | -0.0584 |
| Pod damage (per cent) | 0.0013 | 0.0017 | 0.0062 | -0.0004 | 0.0034 | -0.0008 | 0.0038 | 0.0060 | -0.0282 | -0.1492* |

Diagonal values are direct effects

However, high variance values alone are not the determining factors of the expected progress that could be made in respect of quantitative traits (Fa1coner, 1981) . It was suggested that the GCV together with the high heritability estimates would give a better picture of the extent of genetic gain to be expected under selection.

In the present investigation, all the characters expressed high heritability estimates ranging from 52.2 to 96.7 per cent. The highest heritability was recorded by secondary branches per plant (96.7 %) followed by number of primary branches per plant (93.3%) and number of pods per plant (93.1%). The genetic advance was highest for seed yield (170.98) followed by pods per plant (95.13) while high genetic advance as per cent of mean was exhibited by all the traits studied except days to 50 per cent flowering , plant height and days to maturity. The variability and genetic advance as percent of mean was highest for the characters *viz.,* number of secondary branches per plant, pod damage (%) and number of pods per plant while high heritability coupled with high genetic advance as per cent of mean was noticed for the characters *viz.,* number of secondary branches, number of pods per plant and wilt (%) suggesting the presence of additive gene action controlling these traits. Similar results were reported by Chandirakala and Subbaraman (2010) where heritability is high and genetic advance as per cent of mean is low the environment these traits. The expression of traits is unstable, hence, breeder should not rely on the estimates of heritability alone.

Analysis of variance revealed highly significant differences among the genotypes for all the characters studied. Genotypic and phenotypic correlation coefficients and direct and indirect effects of characters on yield showed that in general, genotypic correlation coefficients were higher than phenotypic correlation coefficients indicating strong inherent association between characters governed largely by genetic causes and are generally less subjected to environmental forces (Table 2 and 3). The nature and magnitude of genotypic correlation coefficients obtained among ten characters revealed that number of primary branches per plant followed by pod damage exhibited positive significant association with seed yield (kg/ha) indicating that the character number of primary branches per plant can be improved simultaneously which is in agreement with the findings of Bhaskaran and Muthaiah (2006).

Number of pods per plant exhibiting positive and significant association with days to 50 per cent flowering, days to maturity, number of primary branches per plant and number of secondary branches per plant as reported by Thanki and Sawargoankar (2010). Number of secondary branches also showed positive significant association with number of primary branches per plant and days to maturity which is in agreement with the reports of Bhadru (2010).

Path coefficient analysis revealed that days to 50 per cent flowering and number of primary branches per plant exhibited high positive direct effects towards seed yield which were in agreement with the findings of Shoran (1982).The residual effect was high indicating the effect of environment is high on the expression of the traits. The material needs further more studies for stabilizing the material.

Based on the studies of associations and path effects, it can be opined that the traits number of primary branches per plant and number of pods per plant can be considered as important for obtaining higher seed yield and therefore, selection may be initiated for improvement of these component traits to achieve higher seed yield.

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