Asian Resonance

# Genetic Variability and Heritability Among Quantitative Traits in Chickpea Under Tropical Region

**J. R.Nizama**
College of Agriculture
Department of Genetics
And Plant Breeding
Navsari Agricultural
University,
Bharuch-Gujarat

**S. R. Patel**
College of Agriculture
Department of Genetics
And Plant Breeding
Navsari Agricultural
University, Bharuch-Gujarat

**A. I. Patel**
College of Agriculture
Department of Genetics
And Plant Breeding
Navsari Agricultural
University, Bharuch-Gujarat

**Abstract**

This research was carried out to estimation of selection criteria by using correlation and path coefficient analysis in 50 genotypes of chickpea *(Cicer arietinum L.)* under tropical condition. In investigated characters, the analysis of variance of 50 genotypes revealed highly significant differences among the genotypes, indicating sufficient amount of variability present among the material genotypes tested. The phenotypic as well as genotypic variances were high for pods per plant, seed yield per plant, harvest index and secondary branches per plant, where as moderate for plant height, 100-seed weight and days to 50% flowering and low for seeds per pod, primary branches per plant, protein content and days to maturity. The GCV was observed high for pods per plant followed by seed yield per plant and 100-seed weight. High heritability estimates were obtained for protein content, 100-seed weight, pods per plant, harvest index, seed yield per plant, days to 50% flowering and secondary branches per plant indicating that these characters were less influenced by environment and direct selection for these characters would be effective for further improvement in yield level. The expected GA mean (%) value was observed high for 100-seed weight followed by pods per plant and seed yield per plant.

**Keywords:** Chickpea, genetic variability, GCV, PCV, heritability, GA.

**Introduction**

Chickpea is traditionally grown in many parts of the world. Like other pulse crops, it has multiple functions in the traditional farming systems in many developing countries. It is also important nourishment for people who do not consume enough animal products in specially developing or under developed countries. Chickpea seeds contain about 16.4-31.2 % crude protein, 38.1-73.3 % carbohydrate, 1.5-6.8 % fat, and 1.6-9.0 % fiber (Singh et al., 1995). Among a dozen of different grain legumes under cultivation in India, gram is the leading crop and is grown in rabi season. Indian subcontinent accounts for 67% of total production of gram in the world. This crop occupies an area of 48.91 and 1.43 lakh hectares in India and Gujarat with an average yield of 720 and 871 kg/ha. It also consumed in the form of processed whole seed (boiled, roasted, parched, fried, steamed, sprouted etc.) or Dal (decorticated split cotyledons boiled and mashed to make a soup) or as Dal flour (besan). Pulses are an integral part of the cropping systems all over the country as they fit well in the crop rotation and crop mixtures. Pulses are important constituents of the Indian diet and supply a major part of protein requirement. For the efficiency of selection depends on the identification of genetic variability from the phenotypic expression of the characters. Assessment of genetic variability in the base population is the first step in any breeding programme. Hence, direct selection based on yield alone is not an efficient approach without giving due to importance to the extent of variability, heritability and genetic advance of yield and its component traits over seasons.

**Material And Method**

Fifty genotypes of chickpea (Cicer arietinum L.) obtained from the germplasm maintained at the College Farm, N. M. College of Agriculture, N.A.U., Navsari, Gujarat during rabi 2010 -11, in a randomized block design (RBD) with three replications. Genotypes were sown in 2 row of 4 meter length with a spacing of 45 x 10 cm. observation of each character, five plants were randomly selected in

each plot. The details regarding the observations are given below: Days to 50 per cent flowering, Days to maturity, primary branches per plant, secondary branches per plant, pods per plant, Plant height (cm.), seeds per pods, Seed yield per plant (g), 100- seed weight (g), Harvest index (%), Protein content (%). The variability parameters were estimated as per the methods suggested by Johanson et al. (1955) and Bowley, (1920).

**Result and Discussion**

Success of the crop improvement programme is largely dependent on the extent of genetic variability present in the population. Environment has a great influence on many quantitative characters, in which the variability partitioned into heritable and nonheritable components like genotypic coefficient of variation, heritability, genetic advance etc. are most important to the plant breeder for selection of the breeding method in crop improvement programme.

The present study revealed the wide range of variability (Table 1). With regards to earliness, moderately high range of variability was observed. The results are in accordance with that for earliness by Sood and Kumari (2000) and Farshadfar and Farshadfar (2008); Primary branches per plant by Muhammad et al. (2008) and Sharma and Saini (2010); Secondary branches per plant by Muhammad et al. (2008) and Borate et al. (2010); Pods per plant by Farshadfar and Farshadfar (2008) and Borate et al. (2010); Seeds per pod by Saleem et al. (2005) and Farshadfar and Farshadfar (2008); 100-seed weight by Meena et al. (2006) and Farshadfar and Farshadfar (2008); Seed yield per plant by Muhammad et al. (2008) and Alwawi et al. (2010); Harvest index by Malik et al. (2010); Protein content by Alwawi et al. (2010) and plant height by Farshadfar and Farshadfar (2008) and Muhammad et al. (2008).

It is of great interest to consider the *per se* performance of different genotypes in quantitative characters of economic view particularly earliness, secondary branches per plant, pods per plant, seeds per pod, 100-seed weight and grain yield. The variety CSJ-662 was found to be the earliest to flower. For primary and secondary branches per plant CSJ-575, GJG-315, GJG-804 and RSG-896 had the maximum branches. The varieties which had born the maximum pods per plant were CSJ-575, GJG-315, GJG-315 and GJG-804. Varieties GG-1, CSJ-575 and GG-2 had the bolder seeds. Highest yielding varieties were CSJ-575, GJG-315, RSG-896 and Gujarat Gram -2.

The phenotypic range of variation is not the precise criterion of judging the amount of genetic variation present in population. The genetic parameters like variance components, GCV, heritability and GA are important to study the extent of genetic variability more precisely. Since breeding potential of experimental material depends on the amount of genetic variability which is a prerequisite for response to selection, the phenotypic variance was partitioned into its genotype and environment components to know the genetic variability present in each character.

The genotypic variance followed the trend of phenotypic variance and was greater than environmental variance for all the characters. This implied that phenotypic variability might be considered as a reliable measure of genotypic variability. In the present study, the phenotypic and genotypic variances were greater than the environmental variances for all **the characters under study (Table 2). This indicated that selections for these characters would be effective.**

With a view to compare different quantitative characters in respect of phenotypic and genotypic variability, PCV and GCV were calculated. The highest amount of GCV was exhibited by pods per plant followed by seed yield per plant, 100-seed weight, secondary branches per plant and branches per plant. Moderate extent of GCV was exhibited by harvest index, protein content and seeds per pod while characters such as days to maturity, days to 50% flowering and plant height possessed low magnitude of GCV. High amount of GCV for pods per plant was reported by Borate et al. (2010) and Akhtar *et al.* (2011); for seed yield per plant by Akhtar *et al.* (2011) and Khan *et al.* (2011).

The broad sense heritability ranged from 15.90 (days to maturity) to 95.90 (protein content). Very high estimates of heritability were observed for the characters, *viz., protein content,* 100-seed weight, pods per plant, harvest index, seed yield per plant, days to 50% flowering and secondary branches per plant. It might be due to the fact that the experiment was conducted only at a single location and for one year. Thus, the genotypic variance estimated from a single test contained interaction to genetic variance in addition to genetic variance resulting in the upward bias in the estimates of broad sense heritability. High estimates of heritability in chickpea were also reported for protein content by Alwawi *et al.* (2010), 100-seed weight and pods per plant by Ozveren et al. (2006). In this manner, crop improvement, in terms of these traits could be possible by selection.

The expected genetic advance (%) of mean was high for characters viz., 100-seed weight, pods per plant, seed yield per plant, secondary branches per plant and protein content, the same results were also obtained on high genetic advance for 100-seed weight by Sood and Kumari (2000)**.**

Protein content, 100-seed weight, pods per plant, harvest index, seed yield per plant and days to 50% flowering showed high heritability along with higher to moderate GCV and higher genetic advance indicating that most likely the heritability was due to additive gene effects and the genotypes under study were highly diverse and of great genetic potential with regard to these characters. Further improvement in these characters would be achieved by phenotypic selection.

**Conclusion**

The phenotypic as well as genotypic variances were high for pods per plant, seed yield per plant, harvest index and secondary branches per plant, The genotypic coefficient of variation was observed high for number of pods per plant followed

by seed yield per plant and 100-seed weight, High heritability estimates were obtained for protein content, 100-seed weight, number of pods per plant, harvest index, seed yield per plant, days to 50% flowering and number of secondary branches per plant, Genetic advance was observed high for 100-seed weight, Therefore, more emphasis should be given to these characters during selection for higher yield in crop improvement programme.

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**Table 1:**
**Analysis of variance for eleven characters studied in chickpea (*Cicer arietinum* L.)**

| Source of variation | d.f. | Days to 50% flowering | Days to maturity | Plant height (cm) | No. of primary branches per plant | No. secondary branches per plant | No. of pods per plant | No. of seeds per pod | Seed yield per plant (g) | 100-seed weight (g) | HI (%) | Protein content (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Replication | 2 | 4.437 | 1.630 | 46.393 | 2.438 | 2.122 | 19.360 | 0.053 | 5.406 | 1.204 | 0.336 | 0.0374 |
| Treatment | 49 | 21.232** | 9.500** | 45.201** | 4.711** | 67.700** | 237.168** | 0.064** | 89.755** | 48.538** | 83.787** | 16.040** |
| Error | 98 | 1.932 | 6.048 | 8.744 | 1.517 | 8.051 | 9.990 | 0.026 | 7.699 | 0.895 | 4.0633 | 0.224 |
| **S.E** | | **0.803** | **1.420** | **1.708** | **0.711** | **1.638** | **1.825** | **0.094** | **1.602** | **0.546** | **1.164** | **0.273** |
| **C.D 5%** | | **2.252** | **3.985** | **4.793** | **1.995** | **4.598** | **5.121** | **0.263** | **4.496** | **1.533** | **3.266** | **0.766** |
| **C.D 1%** | | **2.981** | **5.275** | **6.344** | **2.641** | **6.086** | **6.779** | **0.348** | **5.951** | **2.029** | **4.324** | **1.014** |
| **C.V** | | **2.137** | **2.017** | **6.679** | **14.947** | **10.297** | **7.211** | **11.648** | **10.394** | **4.650** | **4.266** | **2.142** |

***Significant at 0.05 , **Significant at 0.01**

**Table 2: Range, components of variance for genotypic and phenotypic coefficient of variations, heritability, genetic advance and genetic advance in per cent of mean for eleven characters in chickpea (*Cicer arietinum* L.)**

| Characters | Range | $\sigma^2 g$ | $\sigma^2 p$ | $\sigma^2 e$ | GCV (%) | PCV (%) | $H^2$ (b.s.) (%) | GA | GA as % of mean |
|---|---|---|---|---|---|---|---|---|---|
| **Days to 50% flowering** | 54.15-70.69 | 6.433 | 8.365 | 1.932 | 3.899 | 4.446 | 76.9 | 4.582 | 7.043 |
| **Days to maturity** | 115.76-126.18 | 1.147 | 7.195 | 6.048 | 0.878 | 2.200 | 15.9 | 0.881 | 0.723 |
| **Plant height (cm)** | 38.99-56.31 | 12.151 | 20.900 | 8.749 | 7.871 | 10.323 | 58.1 | 5.475 | 12.363 |
| **No. of primary branches per plant** | 5.24-12.96 | 1.065 | 2.581 | 1.517 | 12.525 | 19.501 | 41.3 | 1.365 | 16.570 |
| **No. secondary branches per plant** | 18.20-44.85 | 19.881 | 27.932 | 8.051 | 16.180 | 19.179 | 71.2 | 7.749 | 28.121 |
| **No. of pods per plant** | 28.31-70.88 | 75.726 | 85.716 | 9.990 | 19.854 | 21.123 | 88.4 | 16.849 | 38.443 |
| **No. of seeds per pod** | 1.20-1.98 | 0.013 | 0.039 | 0.026 | 8.105 | 14.191 | 32.6 | 0.133 | 9.535 |
| **Seed yield per plant (g)** | 17.89-38.54 | 27.352 | 35.051 | 7.700 | 19.592 | 22.178 | 78.0 | 9.517 | 35.652 |
| **100-seed weight (g)** | 12.69-27.20 | 15.881 | 16.776 | 0.895 | 19.587 | 20.133 | 94.7 | 7.987 | 39.261 |
| **HI (%)** | 41.06-65.65 | 26.575 | 30.638 | 4.063 | 10.908 | 11.713 | 86.7 | 9.890 | 20.928 |
| **Protein content (%)** | 18.19-27.69 | 5.272 | 5.496 | 0.224 | 10.399 | 10.618 | 95.9 | 4.633 | 20.982 |