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# Studies on Genetic Variability, Heritability and Genetic Advance for Yield, Yield Components and Quality Traits in *Kabuli* Chickpea

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**ABSTRACT**

The present study was undertaken at Regional Agricultural Research Station, Nandyal during *rabi*, 2016-17. Thirty genotypes of *kabuli* chickpea were evaluated in a randomized complete block design with three replications for analysis of variability among the genotypes. Characters *viz.*,seed yield per plant, number of pods per plant, shoot biomass, 100 seed weight, protein content, 100 grain volume, water absorption after soaking, volume expansion after soaking, cooking time for raw seeds and cooking time for soaked seeds recorded high values of heritability as well as genetic advance under both the conditions. Plant height, number of seeds per plant and harvest index under rainfed condition and days to 50 per cent flowering under irrigated condition recorded high heritability and high genetic advance as per cent of mean.

Key words*: Genetic advance as per cent mean, Heritability, Kabulichickpea, Variability.*

Chickpea (*Cicer arietinum* L.) is a self-pollinated crop with diploid chromosome number (2n=2x=16), belongs to the genus *Cicer*, tribe *Ciceraceae*, family *Fabaceae*, subfamily *Papilionaceae* and known to be originated in south-eastern Turkey from where, it spread to other parts of the world. Globally, chickpea is grown in an area of 14.80 million ha. with a production of 14.23 million tons and a productivity of 962 kg per ha. The leading chickpea growing countries are India, Pakistan, Mexico, Turkey, Canada, Iran, Australia, Tanzania, Ethiopia, Spain and Burma. India is the largest producer of chickpea with a production of 9.98 million tons from an area of 10.74 million ha. with a productivity of 920 kg per ha (FAOSTAT, 2016).

In any breeding program development of new varieties largely depends on the amount of genetic variability present in the base material and the extent of genetic variability for the desired character. Natural variation that exist within the species for agronomically and economically important traits may guide the breeder to determine the most effective breeding procedure. The magnitude of genetic coefficient of variability is useful measure for genetic variation present in the population. The concept of heritability indicates the differences among the individuals arose due to differences in genetic makeup or due to environmental factors. Genetic advance provides an information on possible improvement of particular character through selection. Estimates of high heritability together with high genetic advance are more valuable for selection than heritability estimates alone. Hence, considering these aspects, estimates of genetic variability, heritability and genetic advanceas percent of mean studies were carried out with 30 *kabuli* chickpea genotypes in the present investigation.

## MATERIALS AND METHODS

The present study was conducted during *rabi*, 2016-17 at Regional Agricultural Research Station, Nandyal, Andhra Pradesh. Two individual experiments were conducted separately with 30 genotypes in Randomized Block Design (RBD) with three replications i) under rainfed situation (rainfed). ii) with two supplemental irrigations through drip at 35 and 55 days after sowing (irrigated). Each genotype was raised in a single row plot of 4 meter length with inter row spacing of 30 cm and intra row spacing of 10 cm. Observations were recorded on randomly chosen five competitive plants for 19 which include yield, yield contributing characters and quality traits *viz.,*

days to 50 per cent flowering, days to maturity, plant height, number of primary branches per plant, number of secondary branches per plant, SPAD chlorophyll meter reading, number of pods per plant, number of seeds per plant, shoot biomass, harvest index, 100 seed weight, seed diameter, 100 grain volume, protein content, water absorption after soaking, volume expansion after soaking, cooking time for raw seeds, cooking time for soaked seeds and seed yield. The analysis of variance, coefficient of variation was calculated as per Burton and Devane (1953). Genetic advance and heritability in broad sense were calculated as per Johnson *et al.,* (1955).

## RESULTS AND DISCUSSION

In the present investigation, the mean squares from analysis of variance for different characters under rainfed and irrigated conditions were presented in Table 1 and Table 2, respectively. Results of analysis of variance revealed significant differences of mean squares for most of the traits studied indicating the presence of considerable amount of variability in the evaluated material. phenotypic and genotypic coefficient of variation (PCV and GCV)were calculated for 19 characters under rainfed (Table 3) and irrigated (Table 4) conditions.

### High PCV and GCV

Under rainfed condition, the highest PCV (25.33%) and GCV (25.06%) were recorded for seed yield followed by number of pods per plant (26.21%, 21.66%) and number of seeds per plant (25.61%, 20.51%). The present findings are in accordance with the earlier reports of Farshadfar and Farshadfar (2008), Sidramappa *et al*. (2008), Sreelakshmi *et al*. (2010), Akhtar *et al*. (2011), Malik *et al*. (2011), Jivani *et al*. (2013) and Kumar *et al*. (2014) who also observed high GCV and PCV for seed yield and number of pods per plant. However, under irrigated condition, highest PCV (24.71%) and GCV (21.09%) was recorded for number of pods per plant. These results are in accordance with the findings of Vaghela *et al.* (2009), Sreelakshmi *et al*. (2010), Akhtar *et al*. (2011), Jivani *et al*. (2013) for high GCV and PCV for number of pods per plant.

### High PCV and Moderate GCV

Under rainfed condition, shoot biomass per plant recorded high PCV (20.23%) and moderate GCV (19.52%). While under irrigated situation, out of 19 traits studied, number of seeds per plant (21.37%, 14.61%) recorded high PCV and moderate GCV. Moderate GCV for shoot biomass also reported by Vaghela *et al.* (2009), Khan *et al*. (2011).

### Moderate PCV and GCV

Under rainfed condition, plant height (12.76%, 12.17%), number of primary branches per plant (12.82%, 10.19%), number of secondary branches per plant (18.31%, 10.58%), harvest index (16.33%, 15.75%), 100 seed weight (14.47%, 14.41%), 100 grain volume (15.18%, 15.05%), protein content (11.66%, 11.15%), water absorption after soaking (16.93%, 16.77%), volume expansion after soaking (18.12%, 17.99%), cooking time for soaked seeds (18.29%, 18.09%) and cooking time for raw seeds (17.60%, 17.18%) recorded moderate PCV and GCV. Similarly, under irrigated condition, days to 50 per cent flowering (12.26%, 11.61%), shoot biomass per plant (16.05%, 14.77%), 100 seed weight (14.38%, 14.27%), 100 grain volume (14.83%, 14.77%), protein content (10.62%, 10.43%) water absorption after soaking (16.05%, 15.90%), volume expansion after soaking (18.82%, 18.52%), cooking time for soaked seeds (19.37%, 19.17%), cooking time for raw seeds (19.83%, 19.62%) and seed yield per plant (19.14%, 17.89%) recorded moderate PCV and GCV. Similar results of moderate PCV and GCV for shoot biomass per plant were also reported by Khan *et al*. (2011). The current findings of moderate PCV and GCV for days to 50 per cent flowering, 100 seed weight, grain volume, water absorption after soaking, volume expansion after soaking, cooking time for raw seeds and cooking time for soaked seeds are in line with the reports of Tripathi *et al*. (2012).

### High heritability and high genetic advance

Parameters such as seed yield per plant, number of pods per plant, shoot biomass, 100 seed weight, protein content, 100 grain volume, water absorption after soaking, volume expansion after soaking, cooking time for raw seeds and cooking time for soaked seeds recorded high values of

**Table 1. Estimates of genetic parameters for 19 characters in 30 chickpea genotypes under rainfed condition during *rabi* 2016-2017.**

| S. No | Characters | Mean | Range | GCV | PCV | Heritability (%) | G A | GA as % of mean |
|---|---|---|---|---|---|---|---|---|
| 1 | Days to 50% flowering | 36.8 | 31.3-48.3 | 9.41 | 9.98 | 89 | 6.72 | 18.27 |
| 2 | Days to maturity | 78.6 | 72.0-84.7 | 3.86 | 4.12 | 87 | 5.84 | 7.43 |
| 3 | Plant height | 48.3 | 40.6-61.3 | 12.17 | 12.76 | 91 | 11.52 | 23.88 |
| 4 | No. of primary branches | 3.2 | 2.3-4.1 | 10.19 | 12.82 | 63 | 0.53 | 16.68 |
| 5 | No. of secondary branches | 10.2 | 6.3-14.0 | 10.58 | 18.31 | 33 | 1.28 | 12.60 |
| 6 | SCMR | 51.6 | 47.1-58.0 | 4.74 | 5.76 | 68 | 4.14 | 8.03 |
| 7 | No. of pods per plant | 12.4 | 8.3-23.0 | 21.66 | 26.21 | 68 | 4.58 | 36.87 |
| 8 | No. of seeds per plant | 15.0 | 9.7-25.7 | 20.51 | 25.61 | 64 | 5.06 | 33.84 |
| 9 | Shoot biomass | 10.8 | 7.6-15.2 | 19.52 | 20.23 | 93 | 4.18 | 38.82 |
| 10 | Harvest index | 42.6 | 29.5-53.1 | 15.75 | 16.33 | 93 | 13.32 | 31.28 |
| 11 | 100 seed weight | 54.3 | 35.9-66.5 | 14.41 | 14.47 | 99 | 16.05 | 29.57 |
| 12 | Seed diameter | 8.4 | 7.2-9.2 | 5.59 | 6.05 | 85 | 0.89 | 10.62 |
| 13 | 100 grain volume | 51.9 | 33.6-64.7 | 15.05 | 15.18 | 98 | 15.97 | 30.75 |
| 14 | Protein content | 20.6 | 15.3-24.7 | 11.15 | 11.66 | 91 | 4.53 | 21.98 |
| 15 | Water absorption after soaking | 0.56 | 0.34-0.71 | 16.77 | 16.93 | 98 | 0.19 | 34.22 |
| 16 | Volume expansion after soaking | 0.53 | 0.30-0.69 | 17.99 | 18.12 | 98 | 0.19 | 36.81 |
| 17 | Cooking time for raw seeds | 100.2 | 74.3-148.7 | 17.18 | 17.60 | 95 | 34.62 | 34.57 |
| 18 | Cooking time for soaked seeds | 51.4 | 37.7-69.7 | 18.09 | 18.29 | 98 | 18.95 | 36.85 |
| 19 | Seed yield | 4.6 | 2.5-7.5 | 25.06 | 25.33 | 98 | 2.33 | 51.08 |

heritability as well as genetic advance under both the conditions. Plant height, number of seeds per plant and harvest index under rainfed condition and days to 50 per cent flowering under irrigated condition recorded high heritability and high genetic advance as per cent of mean.

Similar findings were reported for seed yield, 100 seed weight, shoot biomass, harvest index by Ali *et al.* (2002), Khan *et al.* (2011) and Bhanurekha (2016); Mishra *et al*. (1994), Patel and Babbar (2004) and Usmani *et al*. (2005) for seed yield per plant. High heritability and genetic advance for days to 50 per cent flowering, number of pods per plant, number of seeds per plant, 100 seed weight, seed volume, hydration capacity, swelling capacity and cooking time were reported by Tripathi *et al.* (2012). It indicated that heritability was due to additive gene effects contributing to these traits. This will help breeder for direct selection of plants on the basis of phenotypic expression of these traits and could expect high genetic gain.

From the current findings, it is to wrap up that under rainfed condition, number of pods per plant and number of seeds per plant, while under irrigated, number of pods per plant showed high PCV, GCV, heritability (broad sense), genetic advance as per cent of mean, indicating that these traits are being governed by additive gene action and simple selection could be effective for further improvement. On the other hand, 100 seed weight, shoot biomass, number of secondary branches per plant and harvest index exhibited moderate to low estimates of genetic parameters under rainfed situation. Similar performance under irrigated situation was exhibited by 100 seed weight, shoot biomass. Hence, intermating of the selected genotypes could be suggested to generate variability followed by selection in later generations to identify superior segregants.

**Table 4. Estimates of genetic parameters for 19 characters in 30 chickpea genotypes under irrigated condition during *rabi* 2016-2017.**

| S. No | Characters | Mean | Range | GCV | PCV | Heritability (%) | G A | GA as % of mean |
|---|---|---|---|---|---|---|---|---|
| 1 | Days to 50% flowering | 38.0 | 33.3-53.7 | 11.61 | 12.26 | 90 | 8.62 | 22.65 |
| 2 | Days to maturity | 82.0 | 74.3-90.7 | 4.81 | 5.15 | 87 | 7.59 | 9.26 |
| 3 | Plant height | 51.5 | 35.8-60.7 | 9.11 | 10.14 | 80 | 8.69 | 16.87 |
| 4 | No. of primary branches | 3.5 | 2.9-4.3 | 8.56 | 10.99 | 60 | 0.48 | 13.73 |
| 5 | No. of secondary branches | 11.2 | 8.0-15.7 | 9.58 | 17.80 | 29 | 1.18 | 10.63 |
| 6 | SCMR | 56.0 | 49.0-60.0 | 2.42 | 4.03 | -36 | -1.68 | -3.00 |
| 7 | No. of pods per plant | 14.8 | 9.7-26.3 | 21.09 | 24.71 | 73 | 5.48 | 37.08 |
| 8 | No. of seeds per plant | 16.3 | 11.3-26.0 | 14.61 | 21.37 | 47 | 3.36 | 20.59 |
| 9 | Shoot biomass | 14.2 | 11.0-18.9 | 14.77 | 16.05 | 85 | 3.97 | 28.01 |
| 10 | Harvest index | 46.0 | 34.4-55.4 | 8.83 | 12.16 | 53 | 6.08 | 13.22 |
| 11 | 100 seed weight | 57.0 | 36.2-67.3 | 14.27 | 14.38 | 98 | 16.64 | 29.18 |
| 12 | Seed diameter | 8.5 | 7.5-9.3 | 4.33 | 4.97 | 76 | 0.66 | 7.77 |
| 13 | 100 grain volume | 55.8 | 34.9-65.2 | 14.77 | 14.83 | 99 | 16.88 | 30.28 |
| 14 | Protein content | 18.7 | 14.5-21.7 | 10.43 | 10.62 | 96 | 3.95 | 21.08 |
| 15 | Water absorption after soaking | 0.57 | 0.35-0.69 | 15.90 | 16.05 | 98 | 0.18 | 32.45 |
| 16 | Volume expansion after soaking | 0.56 | 0.24-0.69 | 18.52 | 18.82 | 97 | 0.20 | 37.54 |
| 17 | Cooking time for raw seeds | 110.6 | 77-155.3 | 19.62 | 19.83 | 98 | 44.23 | 40.00 |
| 18 | Cooking time for soaked seeds | 56.4 | 39.3-78.7 | 19.17 | 19.37 | 98 | 22.04 | 39.07 |
| 19 | Seed yield | 6.5 | 4.4-9.4 | 17.89 | 19.14 | 87 | 2.23 | 34.43 |

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