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# ASSOCIATION AMONG GRAIN YIELD AND MORPHOLOGICAL TRAITS OF CHICKPEA GENOTYPES

Sachin D. Parhe[1]*, P.N. Harer[2] , N.S. Kute[3] and Kunj Chandra[4]

[1-4] Department of Agricultural Botany, Post Graduate Institute,
Mahatma Phule Agricultural University, Rahuri-413 722, Ahmednagar, Maharashtra, India

E-mail: parhe.sachin@gmail.com

## ABSTRACT

Correlation among yield components and their direct and indirect influences on grain yield of Chickpea were evaluated. Seed yield was significantly correlated with traits, *viz.*, number of primary branches plant$^{-1}$, number of secondary branches plant$^{-1}$, plant height, 100 seed weight and number of pods plant$^{-1}$. Path coefficient analysis revealed that 100 seed weight, number of pods plant$^{-1}$ and number of secondary branches plant$^{-1}$ had the highest positive direct effects on grain yield. Improvement of the grain yield can be immensely efficient via 100 seed weight, number of pods plant$^{-1}$, number of primary branches plant$^{-1}$ and number of secondary branches plant$^{-1}$ based selection.

**Key words:** Chickpea, Correlation, Direct and Indirect effects

## INTRODUCTION

Chickpea (*Cicer arietinum L.*) is unique crops having in-built mechanism to trap atmospheric nitrogen through root nodules and restore soil fertility. It is capable of thriving in harsh and fragile environments.

The association of one or more characters influenced by a large number of genes is elaborated statistically by correlation coefficients. Genotypic correlation coefficient provides a measure of genotypes conjugation between characters. The methods of partitioning the correlation into direct and indirect effects by path coefficients analysis was suggested by Wright (1921). It provides useful information on the relative merit of the traits in the selection criterion.

Study of yield components and detecting suitable selection indexes has a very important role in Chickpea breeding programmes. The knowledge About association between yield and yield components facilitates the choice of suitable breeding method to be applied for improving the crops *per se*. Path analysis has been used by plant breeders to assist for identifying useful selectable traits (Dewey and Lu, 1959). Partitioning of the correlation coefficient into its components, one component being the path coefficient that measures the direct effect of a predictor variable upon its response variable; the second component being the indirect effects of a predictor variable on the response variable through another predictor variable is the advantage of path analysis (Dewey and Lu, 1959).

In this study, an attempt was made to study the direct and indirect effects of some important yield components on seed yield of chickpea by correlation and path coefficient analysis. The results obtained would be useful in the selection

criteria in further studies in order to increase the selection efficiency.

## MATERIALS AND METHODS

Total 51 diverse genotypes of Chickpea received from Pulses Improvement Project, MPKV, Rahuri and NBPGR New Delhi were grown in a randomized block design with two replications at Pulses Improvement Project, MPKV, Rahuri during *rabi* 2012-13 in a single row of 3 m length with a spacing of 10 cm between plants and 45 cm between rows. Two border rows were planted at both the sides to reduce the border effect. The recommended package of practices of crop production and protection were followed for successful crop growth. The data was recorded on days for 50 per cent flowering, days to maturity, plant height, primary branches plant $^{-1}$, secondary branches plant $^{-1}$, protein content, seed yield plant $^{-1}$, 100 seed weight and number of pods plant $^{-1}$ were recorded on five plants randomly selected from the rows, in each replication. The correlation was worked out following Panse & Sukhatme (1985) and Path analysis by Following Dewey & Lu (1954).

## RESULTS AND DISCUSSION

The analysis of variance revealed significant genotypic differences for all the characters (Table 1). A wide range of variability was observed for all the characters. The character 100 seed weight exhibited highest range of variability followed by number of pods per plant and days to 50 per cent flowering. Similar results were obtained by Sharma *et al.* (1990), Mathur and Mathur (1996) and Borate *et al.* (2010).

Genotypic coefficient of variation (GCV) was highest for seed yield per plant (39.77 %) followed by 100 seed weight (37.35 %), number of pods per plant (27.23 %), number of secondary branches per plant (23.52%) and number of primary branches per plant (18.65 %). Maximum heritability was observed for 100 seed weight (98.80 %) followed by seed yield per plant (97.14 %), days to 50 per cent flowering (95.49 %), number of pods per plant (94.08) and plant height (91.68 %). High heritability (> 60 %) was observed in all the characters studied (Table 2).

The phenotypic and genotypic correlation of yield per plant and its components are shown in Table 3. These correlation studies revealed that, the genotypic correlation coefficients between most of the characters were higher in magnitude than the phenotypic correlation coefficients indicating strong inherent association between various characters studied and that the genotypic expression of the correlation was comparatively less influenced by the environmental conditions. Similar findings were also reported by Singh *et al.* (1994) and Sharma and Maloo (1987). The significant positive correlation was reported between seed yield per plant with number of secondary branches per plant, number of pods per plant and 100 seed weight. It plays an important role in producing higher yield in

**Table 1. Analysis of variance for nine different characters in Chickpea.**

| Sr. No. | Characters | Mean sum of square | |
|---|---|---|---|
| | | Genotype (d.f.50) | Error (d.f.50) |
| 1. | Days to 50 % flowering | 94.799** | 2.187 |
| 2. | Days to maturity | 34.154** | 2.116 |
| 3. | Plant height (cm) | 74.850** | 3.250 |
| 4. | Number of primary branches per plant | 1.6966** | 0.292 |
| 5. | Number of secondary branches per plant | 16.199** | 1.039 |
| 6. | Number of pods per plant | 569.374** | 17.366 |
| 7. | 100 seed weight (g) | 68.705** | 0.414 |
| 8. | Seed yield per plant (g) | 27.152** | 0.393 |
| 9. | Protein content (%) | 4.782** | 1.407 |

*, ** indicates significant at 5 and 1 per cent Level respectively

chickpea. Selection of parents or genotypes based on such traits is adopted for improvement in chickpea. These result are in agreement with the findings of Paliwal *et al.* (1987), Tagore and Singh (1990), Deshmukh and Patil (1995), Muhammad *et al.* (2004), Talebi *et al.* (2007) and Ali *et al.* (2009). Protein content showed negative significant association with plant height, suggesting that higher plant height is associated with low protein content in chickpea. It also had negative association with seed yield. Tyagi *et al.* (1982) also found negative association between seed yield and protein content in chickpea.

Similarly strong association between primary and secondary branches per plant and number of pods per plant was noticed through the highly significant positive values of correlation coefficients. This indicates the simultaneous improvement of these characters through selection.

The importance of this association was also reported by Singh *et al.* (1994) and Sandhu (1991). Similarly, days to 50 per cent flowering was strongly associated with days to maturity, plant height and number of primary branches per plant suggesting that maturity period can be predicted by days taken to 50 per cent flowering. A negative correlation of these characters observed with seed yield per plant, number of pods per plant will help in developing early maturity and high yielding varieties.

The direct and indirect contributions of each character as revealed by path coefficient analysis (Table 4) indicated that 100 seed weight had highest direct effect on seed yield per plant followed by number of pods per plant and number of secondary branches per plant. These direct effects are mainly responsible for significant positive association of these characters with seed yield per plant. The number of secondary branches exerted its effect on seed

**Table 2. Estimates of variability parameters for nine different characters of Chickpea**

| Sr. No. | Name of the characters | Range | $\sigma^2g$ | $\sigma^2p$ | $\sigma^2e$ | GCV (%) | PCV (%) | $h^2$ (b.s.) (%) | G.A. | G.A. as % of mean |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Days to 50 % flowering | 42.50-72.02 | 46.30 | 48.49 | 2.18 | 12.91 | 13.21 | 95.49 | 17.55 | 33.32 |
| 2. | Days to maturity | 98.00-119.00 | 16.01 | 18.13 | 2.11 | 3.72 | 3.96 | 88.33 | 9.931 | 9.245 |
| 3. | Plant height (cm) | 32.80-64.70 | 35.79 | 39.05 | 3.25 | 13.72 | 14.33 | 91.68 | 15.12 | 34.70 |
| 4. | Number of primary branches per plant | 2.90-6.30 | 0.70 | 0.99 | 0.29 | 18.65 | 22.20 | 70.58 | 1.858 | 41.36 |
| 5. | Number of secondary branches per plant | 7.20-20.10 | 7.58 | 8.61 | 1.03 | 23.52 | 25.08 | 87.95 | 6.816 | 58.23 |
| 6. | Number of pods per plant | 30.20-104.20 | 276.00 | 293.37 | 17.36 | 27.23 | 28.08 | 94.08 | 42.54 | 69.74 |
| 7. | 100 seed weight (g) | 9.59-32.45 | 34.14 | 34.56 | 0.41 | 37.35 | 37.58 | 98.80 | 15.33 | 98.03 |
| 8. | Seed yield per plant (g) | 3.60-21.03 | 13.37 | 13.77 | 0.39 | 39.77 | 40.35 | 97.14 | 9.517 | 103.48 |
| 9. | Protein content (%) | 17.38-25.12 | 1.687 | 3.095 | 1.40 | 5.882 | 7.966 | 54.50 | 2.532 | 11.466 |

**Table 3. Genotypic (above diagonal) and Phenotypic (below diagonal) correlation of different characters in Chickpea**

| Sr. No | Days to 50 % flowering | Days to maturity | Plant height (cm) | Number of primary branches per plant | Number of secondary branches per plant | Number of pods per plant | 100 seed weight (g) | Protein content (%) | Seed yield per plant (g) |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1. | **1.0000** | 0.7981** | 0.4882** | 0.4572** | -0.0001 | -0.3024* | -0.1531 | -0.1940 | -0.3922** |
| 2. | 0.7873** | **1.0000** | 0.5307** | 0.3921* | -0.0680 | -0.3489** | -0.0001 | -0.0516 | -0.2970* |
| 3. | 0.4475** | 0.4628** | **1.0000** | 0.3361* | 0.1822 | 0.0008 | 0.1615 | -0.5266** | 0.0319 |
| 4. | 0.3787** | 0.3098* | 0.2984* | **1.0000** | 0.4286** | 0.0954 | 0.0750 | -0.0278 | 0.0235 |
| 5. | -0.0055 | -0.0639 | 0.1762 | 0.4477** | **1.0000** | 0.7175** | -0.0721 | -0.0879 | 0.6892** |
| 6. | -0.2845* | -0.3139* | 0.0090 | 0.1411 | 0.7078** | **1.0000** | -0.2440* | -0.0386 | 0.4343** |
| 7. | -0.1435 | 0.0116 | 0.1528 | 0.0625 | -0.0673 | -0.2420* | **1.0000** | -0.0084 | 0.7153** |
| 8. | -0.1801 | -0.0645 | -0.3542** | -0.1131 | -0.0850 | -0.0173 | -0.0222 | **1.0000** | -0.0376 |
| 9. | -0.3707** | -0.2616* | 0.0356 | 0.0591 | 0.3895** | 0.4428** | 0.7094** | -0.0377 | **1.0000** |

***, ** indicates significant at 5 % and 1% level of probability respectively.*

**Table 4. Direct and Indirect effects of different characters on seed yield in Chickpea**

| Sr. No. | | Days to 50 % flowering | Days to maturity | Plant height (cm) | Number of primary branches per plant | Number of secondary branches per plant | Number of pods per plant | 100 seed weight (g) | Protein content (%) | Total genotypic correlation with seed yield per plant |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | **Days to 50 % flowering** | **0.0260** | 0.0284 | -0.0826 | -0.0496 | 0.0000 | -0.1909 | -0.1399 | 0.0163 | -0.3922** |
| 2. | **Days to maturity** | 0.0207 | **0.0356** | -0.0898 | -0.0425 | -0.0051 | -0.2209 | -0.0001 | 0.0044 | -0.2970** |
| 3. | **Plant height (cm)** | 0.0127 | 0.0189 | **-0.1691** | -0.0364 | 0.0136 | 0.0005 | 0.1476 | 0.0444 | 0.0319 |
| 4. | **Number of primary branches per plant** | 0.0119 | 0.0140 | -0.0568 | **-0.1048** | 0.0319 | 0.0602 | 0.0685 | 0.0023 | 0.0235 |
| 5. | **Number of secondary branches per plant** | 0.0000 | -0.0024 | -0.0308 | -0.0465 | **0.0745** | 0.4529 | -0.0659 | 0.0074 | 0.3892** |
| 6. | **Number of pods per plant** | -0.0079 | -0.0124 | -0.0001 | -0.0103 | 0.0535 | **0.6311** | -0.2228 | 0.0033 | 0.4343** |
| 7. | **100 seed weight (g)** | -0.0040 | 0.0000 | -0.0273 | -0.0081 | -0.0054 | -0.1540 | **0.9134** | 0.0007 | 0.7153** |
| 8. | **Protein content (%)** | -0.0050 | -0.0018 | 0.0891 | 0.0030 | -0.0066 | -0.0244 | -0.0077 | **-0.0842** | -0.0376 |

*Residual effect = 0.263, Underlined figures indicate direct effect.*

**, ** indicates significant at 5 and 1 % level of probability respectively.*

yield through number of pods per plant and 100 seed weight through primary branches per plant which is similar to finding of Tagore and Singh (1990), Tripathi *et al.* (1995), Jeena and Arora (2002), Noor *et al.* (2003) and Talebi *et al.* (2007).

Based on findings of the present investigations it could be enforced that the most desirable plant type in chickpea should possess more number of primary and secondary branches per plant, number of pods per plant and higher 100 seed weight, i.e. bold seeds.

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