Correlation Analysis for Quantitative Traits in a Mapping Population of Chickpea (*Cicerarietinum* L.) Developed for Seed Traits

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Abstract: The present studies were conducted to the estimation of correlation for quantitative traits in a mapping population developed for seed traits in chickpea (Cicer arietinum L.). *The studies indicated a high positive and significant correlation in the Recombinant Inbred lines for the traits number of seeds per pod and 100-seed weight with yield. The biparental mapping population would not only serve as a source for mapping the genes but also provide breeders with valuable breeding material for carrying out selection and improving the targeted traits.*

Keywords: Cicer arietinum, *correlation, phenotypic, chickpea.*

INTRODUCTION

Chickpea is one of the world's most important pulse crops, ranking third in world food legume production. The global area under chickpea production is about 13.5 Mha, with total production of 13.1 Mt and productivity of approximately 967.6 kg/ha (FAOSTAT,2013). India is the world's biggest producer, with an annual production of around 6.54 Mt, representing 66% of total world chickpea production covering an area of 9.6 mha (FAOSTAT, 2013). However, existing production in India is insufficient to meet increasing demand and on average India imports an average of 186,000 tonnes ($US 74 million) p.a. (1998-2007).

Chickpea offers significant benefits for human health. The seed is high in protein (20-30%) and dietary fibre , contains approximately 40% carbohydrates and only 3-6% oil (Gil *et al.*, 1996). Furthermore, chickpea is a good source of essential minerals such as calcium, magnesium, potassium, phosphorus, iron zinc and manganese, and has been recognised as one of the nutritionally best composed dry legumes for human consumption (Ibrikci *et al.*, 2003). Chickpea is a diploid species *i.e.* $2n = 2x = 16$. Its genome size is approximately 931 Mbps (www.rbgkew.org.uk/cval). It is highly self pollinated with an out crossing rate of less than 1%. Chickpea serves as an important source of protein in human diet and thus plays an important role in food economy of the country. They are a rich source of zinc, folate and protein and are high in dietary fiber and hence a healthy source of carbohydrates for persons with insulin sensitivity or diabetes. These are low in fats and most of this is polyunsaturated.

One hundred grams of mature boiled chickpeas contain 164 calories, 2.6 g of fat, and 7.6 g of dietary fiber and 8.9 g of proteins. Chickpeas also provide dietary phosphorous (49-53 mg/100g). According to ICRISAT, chickpeas contain on an

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average 23% proteins, 64% total carbohydrates (47% starch, 6% soluble sugars), 5% fats, 6% crude fibers, 3% ash. There is also high reported mineral content *i.e.* phosphorous (340mg/100g), Ca, Mg (140mg/100g), Fe (7mg/100g) and zinc (3mg/100g).

MATERIALS AND METHODS

Seed traits are very important factors in improving yield and productivity of chickpea. However being quantitative in nature, gains through direct selection for these traits particularly for bolder seed size with higher yield were never successful and thus the way forward is to identify QTLs linked to these traits. Such a study requires development of mapping populations segregating for traits of interest. Mapping population of the cross SBD 377 (Desi Bold Type with 100 seed weight 48g and seed number per plant of 34 per plant) and BGD 112 (Desi small seeded with 100 seed weight of 12-15g and seed number per plant of 90) was developed at Division of Genetics, IARI. The recombinant inbred line (RILs) have been extensively phenotyped.

Contrasting variability exists among the RILs for quantitative characters studied. Plant height ranged from 20 to 70 cm with 1-4 primary branches, 0-23 secondary branches and 7-54 total branches per plant. Number of seeds ranged 5 to 250 seeds per plant and pod number 5-180 per plant. The range of 100 seed weight was 13-50 g. Plant yield varied from 2-69 g. Availability of such a RIL population shall serve as a good base for the QTL analysis. The variability in this population was studied by Tapan *et al.* 2015. Correlations in this biparental population were calculated as given by Steel and Torrie, 1997.

RESULTS AND DISCUSSION

The results indicate that phenotypic correlations coefficients of number of days taken to flowering with seeds per pod and 100 seed weight were negative. A positive but non-significant association was recorded between days taken to flowering and seeds per plant and grain yield. Plant height had a positive non-significant correlation with yield. Days to maturity was significantly and positively correlated with 100 seed weight and number of per plant and positively but non-significantly correlated with grain yield per plant. Similar results have been obtained by Yadav *et al.* (2001). Such positive correlations can occur as the genotypes which were early to flowering and late in maturity had greater time for seed fill period. Thus it had a negative correlation with days to flowering indicating late flowering types were significantly not superior in yielding. Genotypic correlation between plant height and seed yield per plant have already been reported by Obaidullah *et al.* (2006). Seeds per pod though had positive correlation with grain yield but it was non-significant.

Further it had negative correlation with 100 seed weight indicating that by selecting for greater number of seeds per pod would lead to reduction in 100 seed weight. Gaikward *et al.* 2011 also reported that seed yield per plant exhibited highly significant positive association with, number of pods per plant, secondary branches per plant, 100 seed weight and reaction to insect pest (*heliothis*) at both the genotypic and phenotypic levels. However it may slightly increase the yield due to its non-significant positive correlation with

Table 1
Values of phenotypic correlation coefficient analysis observed among the studied traits in chickpea

	Days to maturity	Plant Height	seeds per pod	100 seed weight	seeds per plant	Grain Yield
Days to Flowering	0.2231	0.0945	–0.1120	–0.2102*	0.0123	0.057
Days to maturity		0.1824*	0.1761*	0.1124*	0.2122*	0.1456
Plant height			0.1291*	0.1649*	0.3295*	0.2127*
seeds per pod				-0.297	-0.249	0.1425*
100 seed weight					0.1525	0.1967**
Seeds per plant						0.3371**

*at 5 % level of significance, **at 1 % level of significance.

plant yield. The grain yield per plant was significantly correlated with 100 seed weight, plant height and seeds per plant. These can be used as selection indices for exercising selection by plant breeders. Similar findings have also been reported by Shafique *et al* 2016., Singh *et al.* (1997) and Jeena and Arora (2001). If breeders have to select for higher yield in Indian conditions seeds per plant always serves as the best selection criteri along with 100 seed weight.

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