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GENETIC VARIABILITY FOR PLANT GROWTH AND CROP-YIELD TRAITS IN CHICKPEA (*CICER ARIETINUM* L.)

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ABSTRACT

The present studies were conducted in the field of Plant Breeding and Genetics, University of Agriculture, Faisalabad, during the crop season 2008-2009. It was concluded from correlation studies that biomass per plant, number of pods per plant, number of secondary branches per plant, number of seeds per pod and 100-seed weight were positive and significant at genotypic level but positive and highly significant at phenotypic level which indicated that selection for high yielding genotypes can be made on the basis of these traits.

Key words: *Cicer arietinum,* correlation, genetic variability, chickpea, Pakistan.

INTRODUCTION

Among the pulses, chickpea (*Cicer arietinum* L.) is the third leading grain legume in the world and first in the South Asia. Ninety two percent of the area and eighty nine percent of the production of grain are concentrated in semi-arid tropical countries **[1]**. The range of cultivation of chickpea extends from the Mediterranean basin to the Indian sub-continent and south Ethiopia and the East African highlands. There are two types of chickpea, one namely Kabuli is grown in temperate regions while the desi type chickpea is grown in the semi-arid tropics **[2]**. Chickpea is the principal rabi pulse crop and important source of calories in Pakistan which is predominantly grown in the vast rainfed areas of the country. Pakistan ranks the second to India in terms of acreage of chickpea which is 1050 thousand hectares with an annual production of 571 thousand tones **[3]**. It is rich and readily available source of protein both for human and animals. The average yield of chickpea is low as compared to other chickpea growing countries. In Punjab about 90% gram is cultivated in rainfed areas; the major chickpea production belt is Thal including the districts of Bhakhar, Mianwali, Layyah, Khushab and parts of Jhang. Chickpea is the cheapest and readily available source of protein (19.5%), fats (1.4%), carbohydrates (57-60), ash (4.8%) and (4.9-15.59%) moisture **[4]**. It makes up the deficiency of cereal diets. It also helps with replenishment of soil fertility by fixing of atmospheric nitrogen through symbiosis coupled with deep root system. Grain yield is of primary importance and the most complex trait as it is dependent upon the interaction of growth, environment and genetic make-up of the plant. Apart from direct selection for grain yield, the objective of yield enhancement may in most situations be more effectively fulfilled on the basis of performance of yield and its components. These components contribute to grain production both directly. Genotypic and phenotypic correlations are of value to indicate the degree to which various quantitative traits of the plant are associated with economic productivity. Correlation study thus provides information on correlate response of important plant traits and therefore leads to a directional model for yield response. Many workers, however, expressed apprehension about total reliance on yield components analysis **[5]**. Several new approaches in recent years have therefore, been developed to precisely figure out the exact contribution of various yield components. The present study was initiated with the prime objective of observing the mutual relationships of different quantitative traits at maturity level, also the type and extent of their contribution to seed yield. The studies thus clearly envisage augmenting the relatively scarce information available on these characters which may be profitably exploited in future programmes of chickpea improvement.

MATERIALS AND METHODS

The present studies were conducted in the field of the department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, during the crop season 2008-2009. The experimental material comprised twenty chickpea genotypes, i.e. Viz 698, 820, 205, 1205, 1288, AUG-27, M-98, 114, 115, 117, 781, 1049, 4025, 5006, Paidar-91, PB-2000, 818, 870, 101, 620. Analysis of variance for all characters, i.e. Viz leaflets per leaf, leaf area, primary branches per plant, secondary branches per plant, plant height, biomass per plant, number of pods per plant, number of seeds per pod, number of grain per plant, 100-seed weight and grain yield per plant were carried out using the method of **[6]** and individual comparison of varietals mean was accomplished by Duncan's New Multiple Range Test. Genotypic and phenotypic correlations were calculated to observe the association between different traits **[7]**.

RESULTS AND DISCUSSIONS

It is clear from the **Table 1** that the genotypic and phenotypic correlations coefficients of leaflet per leaf with biomass, primary branches per plant and secondary branches per plant were negative and non-significant. A positive but non-significant association was noted between leaflet per leaf and 100-seed weight. Other associations were positive and non-significant for leaf area, plant height and number of pods per plant. The significant and positive association was found between leaflets per leaf, number of grains per plant and grain yield per plant. Similar results have been obtained by **[8, 9]**. Positive and significant correlation coefficient was found for leaf area with number of pods per plant and grain yield at genotypic level but for grain yield highly significant at phenotypic level. Similar results have been obtained by **[10, 11]**. Genotypic correlation between plant height and number of primary branches per plant was positive and non-significant as well as non-significant at phenotypic level. The significant correlation between plant height and grain yield per plant could be attributed to the disruption in pod filling and grain development. Similar results have already been reported by **[11]**. Non-significant genotypic and phenotypic correlation coefficients of number of primary branches per plant with number of secondary branches per plant were found. Genotypic and phenotypic correlation coefficients of number of primary branches per plant with of number of pods per plant and seeds per pod were positively significant. The grain yield per plant was negatively and significantly correlated with number of primary branches per plant. The secondary branches per plant are directly related with the grain yield which indicated that selection can be made on the basis of primary and secondary branches per plant. Similar results have been obtained by **[8, 12, 13]** who observed positive correlation between primary branches per plant and seeds per pod. Genotypic correlation between secondary branches per plant and seeds per pod was positively significant at phenotypic level. Since secondary branches per plant seemed to be an important yield component and in present studies this character exhibit an association with grain yield per plant. The secondary branches per plant were positively and significantly correlated with grain yield per plant. Similar findings have also been reported by **[14, 15]**.

Correlation coefficients of biomass per plant with number of pods per plant, number of branches per plant, number of secondary branches and plant height were positive and significant at phenotypic level and genotypic levels. The correlation of biomass per plant was positive and significant with the seeds per plant, number of grains per plant and grain yield per plant. Strong positive genotypic and phenotypic correlation of biomass per plant was with number of grain per plant and 100-seed weight. Almost similar results have already been reported by **[15, 16]**. A positive and significant genotypic and phenotypic correlation was found for number of pods per plant with biomass per plant and number of secondary branches per plant but highly significant genotypic correlation with secondary branches per plant. So number of pods per plant should be used as selection for yield improvement in chickpea **[17]**. A positive but significant genotypic correlation was found for number of seeds per pod with secondary branches per plant and biomass per plant but highly significant at phenotypic level for biomass per plant. Seeds per pod were positive and non-significant with number of grain per plant at genotypic and phenotypic level. Similar results were found by **[8, 18, 19]**. 100-seed weight was positively and significantly correlated with seeds per pod at genotypic but not significant at phenotypic level. Genotypic and phenotypic correlation coefficient between 100-seed weight and grain yield per plant and secondary branches per plant was negative and significant. A positive and significant genotypic and phenotypic correlation of number of pods per plant with biomass per plant, leaflets per leaf, and number of primary branches per plant but highly significant genotypic correlation with biomass per plant. So number of grains per plant should be used as selection for yield improvement in chickpea [**17**].

CONCLUSIONS

It was concluded from correlation studies that biomass per plant, number of pods per plant, number of secondary branches per plant, number of seeds per pod and 100-seed weight were positive and significant at genotypic level but positive and highly significant at phenotypic level which indicated that selection for high yielding genotypes can be made on the basis of these traits.

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Table 1: Genotypic and phenotypic correlation of various quantitative traits

Traits	r	NDM	PH	NPP	NPB	NSB	DW	100-SW	NSPP	NGP	GY
LL	G	0.15310	0.11245	0.02513	0.05123	-0.11271	-0.03645	0.14576	-0.89452**	0.72481*	0.69251*
	P	0.19754	0.14351	0.45121*	-0.02415	-0.23521	-0.05864	0.10354	-0.49257*	0.20129	0.38129*
LA	G		-0.05412	0.20350	-0.29452*	0.20452	-0.24561	-0.46987*	-0.20311	-0.21235	0.89745**
	P		0.02143	0.00164	-0.21237	0.10145	-0.14523	-0.11249	-0.12514	-0.20210	0.49251*
PH	G			-0.01891	0.061203	-0.66235**	-0.12312	-0.39874*	-0.49856*	-0.12365	-0.04251
	P			0.04132	0.03421	-0.38982*	-0.62810*	-0.13238	-0.29845*	-0.10135	-0.03541
NPP	G				-0.20123	0.55652**	0.28752*	-0.20452	-0.39872*	-0.18025	0.06453
	P				-0.05412	0.12716	0.14528	-0.14122	-0.05125	-0.08753	0.06543
NPB	G					0.12143	-0.11071	-0.20126	0.49874*	0.39746**	-0.82112**
	P					0.01244	0.01424	-0.13653	0.28762*	0.39425*	-0.56421*
NSB	G						0.220983	-0.49874**	0.35784*	0.69514*	0.45301*
	P						0.114553	-0.24505	0.29819*	-0.29323*	0.36511*
DW	G							-0.45478*	0.76998**	0.39452**	0.39416**
	P							-0.12013	0.29544*	0.48562**	0.01283
100-SW	G								0.49874**	-0.01269	-0.52436**
	P								0.32564*	-0.25631*	-0.29865**
NSPP	G									0.42546*	-0.41205*
	P									0.131423	-0.29872*
NGP	G										-0.11021
	P										-0.36584

* = Significant at 5% probability level
** = Highly significant at 1% probability level
LL = leaflet per leaf
NPP = Number of pod per plant
LA = Leaf area
NSPP = Number of seeds per pod
PH = Plant height
HSW = 100-seed weight
NPB = Number of primary branches per plant
GYP = Grain yield per plant
NSB = Number of secondary branches per plant
NGP = Number of grains per plant