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Correlation analysis for quantitative traits in chickpea genotypes (*Cicer arietinum* L.)

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The present studies were conducted to the estimation of correlation for quantitative traits in chickpea (*Cicer arietinum* L.) in the field of the department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, during the crop season 2009 to 2010. Correlation studies showed 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. Whereas number of days taken to flowering, number of days taken to maturity, primary branches per plant, secondary branches per plant were positively correlated with the grain yield per plant at genotypic and phenotypic levels. Plant height was negative and non-significantly correlated with grain yield per plant at both genotypic and phenotypic levels.

Key words: *Cicer arietinum,* correlation, genotypic, phenotypic, 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 (Anonymous, 1995). Its range of cultivation extends from the Mediterranean basin to the Indian sub-continent and south ward of Ethiopia and the East African highlands. Two types of chickpea, one namely Kabuli is grown in temperate regions while the desi type chickpea is grown in the semi-arid tropics (Muehlbauer and Singh, 1987). 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 second to India in terms of acreage under chickpea which is 1050 thousand hectares with an annual production of 571 thousand tones (Anonymous, 2009, 2010). 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 to 60), ash (4.8%) and (4.9 to 15.59%) moisture (Huisman and Van der Poel, 1994). It makes up the deficiency of cereal diets. It also helps in replenishment of soil fertility by

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Table 1. Estimates of genetic components.

Quantitative traits	G V	PV	EV	GCV (%)	PCV (%)	ECV (%)	Broad-sense heritability(h^2)%	Genetic advance (%)
Days taken to flowering	50.6521	36.3710	2.5410	1.9466	1.6495	0.4359	56.6	1.5219
Days taken to maturity	12.5410	9.3915	1.1564	0.9686	0.8382	0.71	51.6	1.1181
Plant height	16.8033	19.6403	2.8369	1.1212	9.28	3.53	85.6	5.3028
Primary branches per plant	5.0021	0.0127	0.0058	0.6117	4.45	3.01	54.1	0.0854
Secondary branches per plant	30.0141	21.283	0.1553	1.4985	1.2618	4.84	47.9	0.3665
Biomass per plant	9.0809	17.3115	8.2708	1.1380	4.92	3.40	52.2	3.0420
Pods per plant	58.1481	65.2329	17.0445	2.0857	16.52	8.45	73.9	8.3529
Seeds per pod 100-	16.0021	12.014	9.2141	1.0941	0.9480	0.8305	47.0	0.0438
seed weight Grain	20.886	19.1431	12.8043	3.6912	0.9787	4.13	48.8	0.7151
yield per plant	32.2914	5.3477	1.1554	0.6325	5.69	3.53	61.5	1.9926
Grains per plant	21.7217	34.5260	5.8043	5.38	6.78	0.6589	62.9	5.1755

fixing of atmospheric nitrogen through symbiosis coupled with deep root system.

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 2009 to 2010. The experimental material comprised twenty chickpea genotypes namely: Noor 91, Bittle 98, 210, 1288, 9605, 220, 1276, 1017, 2006, 848, 214, 405, 880, 2008, 219, 4009, 846, 1154, 290 and 868. Analysis of variance for all characters were carried out using the method of Steel and Torrie (1997) 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 (Kwon and Torrie, 1964).

RESULTS AND DISCUSSION

Genetic parameters of yield and their components are given in Table 1. In the present study, the highest genotypic variances were found for NPP (58.1481), NDF (50.6521), GYP (32.2914), NSB (30.0141), and GPP (21.7217) while lowest genotypic variance was found for BM (9.0809) and NPB (5.0021). The highest phenotypic variances were found for NPP (65.2329), NDF (36.3710), GPP (34.526), NSB (21.283) and PH (19.6403) while lowest for NPB (0.0127). The highest environmental variance was found for NPP (17.0445) while lowest for NPB (0.0058). The highest genotypic coefficient of variances was found for GPP (5.38%) while lowest genotypic coefficient of variance was found for NBP (0.6117%). The highest phenotypic coefficient of variances was found for NPP (16.20%) while lowest phenotypic coefficient of variance was found for NDM (0.8382%). The highest environmental coefficient of variances was found for NPP (8.45%) while lowest environmental coefficient of variance was found for NDF (0.4359%). Similar findings were reported by Adhikari and Pandey (1982). The higher values of genetic advance were found for NPP (8.3529%), PH (5.3028%), and GPP (5.1755%) while lower for SPP (0.0438%) and NPB (0.0854%). The greater values of genetic advance indicated that NPP, PH and GPP can be used for selecting higher yielding genotypes (Raval and Dobariya, 2003). The highest heritability (85.60%) was found for plant height. The range of heritability from 47.0 to 85.60%. The greater values of heritabilities were found for PH, GPP, GYP and NPP while lowest values were for 100-seed weight, SPP and NPB and others have moderate type of heritability. The higher value of heritability for grain yield per plant, number of grains per plant and pods per plant indicates that these characters can be used as the genetic parameters for the improvement and selection of high yielding genotypes. These results were in accordance with the findings of Dasgupta et al. (1992). The BMP and GY per plant indicated high heritability coupled with genotypic variation by using Mather and Jinks (1982) model of heritability. Crop improvement could be possible by simple selection because high heritability coupled with high genotypic variation revealed the presence of an additive gene effect (Noor et al., 2003). On the other hand, low heritability coupled with low genotypic variation was observed for 100-seed weight, NPB and NSP. The results indicated that these traits were greatly influenced by the environment (Arshad et al., 2002).

A study of Table 2 shows that the genotypic and phenotypic correlations coefficients of number of days taken to flowering with biomass, primary branches per plant and secondary branches per plant were negative and non-significant. A positive but non- significant association was recorded between days taken to flowering and 100-seed weight, days taken to maturity,

Table 2. Genotypic and phenotypic correlation of various quantitative traits.

Traits	r	NDM	PH	NPP	NPB	NSB	DW	100-SW	NSPP	NGP	GY
NDF	G	0.175863	0.106041	0.081193	0.054416	-0.17061	-0.03977	0.179816	-0.97764**	0.547283*	0.739361*
	P	0.204305	0.113903	0.04101*	-0.02984	-0.21656	-0.04951	0.100843	-0.41997*	0.283169	0.317849*
NDM	G		-0.03723	0.245055	-0.25962*	0.227331	-0.40894	-0.42416*	-0.26711	-0.25621	0.918132**
	P		0.020765	0.006464	-0.25827	0.101509	-0.21399	-0.19709	-0.1254	-0.2153	0.451*
PH	G			-0.01889	0.062383	-0.60747**	-0.12268	-0.31721*	-0.46792*	-0.12127	-0.04263
	P			0.043174	0.030369	-0.38764*	-0.06821*	-0.13808	-0.27691*	-0.10022	-0.05191
NPP	G				-0.23156	0.550029**	0.293602*	-0.20052	-0.30691*	-0.18041	0.080245
	P				-0.0664	0.351766	0.191958	-0.15202	-0.05795	-0.09649	0.092244
NPB	G					0.141073	-0.12771	-0.22406	0.475881*	0.31826**	-0.77384**
	P					0.07444	0.023474	-0.13853	0.217878*	0.296044*	-0.50716*
NSB	G						0.220983	-0.47098**	0.365295*	-0.59944*	0.479671*
	P						0.114553	-0.3505	0.285029*	-0.21083*	0.265961*
DW	G							-0.40878	0.776128*	0.352163**	0.3406**
	P							-0.1603	0.29634	0.409597**	0.082493
100-SW	G								0.468291**	-0.08899	-0.44762**
	P								0.125769*	-0.14323*	-0.22423**
NSPP	G									0.400528*	-0.34051*
	P									0.151283	-0.20138*
NGP	G										-0.13967
	P										-0.23277*

* = Significant at 5% probability level, ** = Highly significant at 1% probability level, NDF = Number of days taken to flowering, NPP= Number of pod per plant, NDM = Number of days taken to maturity, 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.

plant height and number of pods per plant. Days to flowering were significant and positively correlated with number of grains per plant and grain yield per plant. Similar results have been obtained by Yadav et al. (2001). Positive and significant correlation coefficient of number of days taken to maturity with number of pod per plant and grain yield at genotypic level but for grain yield highly significant at phenotypic level. Similar results have been obtained by Raval and Dobariya (2003) and Obaidullah et al. (2006). 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 Obaidullah et al. (2006) . Genotypic and phenotypic correlation coefficients of number of primary branches per plant with number of secondary branches per plant were not significant. 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. Similar results have been obtained by Wadud and Yaqoob (1989) and Bhaduoria et al. (2003) observed positive correlation between primary branches per plant and seeds per pod. Genotypic correlation between secondary branches per plant and seeds per pod was negatively 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 Singh et al. (1997) and Jeena and Arora (2001).

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 but not significant association was with 100-seed weight. Almost similar results have already been reported by Jeena and Arora (2001) and Arshad et al. (2002).

A positive and significant genotypic and phenotypic correlation of 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 (Chavan et al., 1994. A positive but significant genotypic correlation of 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 Ozcelik et al. (2004) and Bicer (2005) . A positive but significant correlation of 100-seed weight 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, days to flowering, 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 (Chavan et al., 1994).

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