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Research Note

Genetic variability and trait association in chickpea (*Cicer arietinum* L.)

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Abstract :
A study was carried out in the experimental area of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan during 2007-2008. Twenty elite genotypes and three standard varieties of chickpea were evaluated for *per se* and components of variability, heritability (h^2bs), genetic advance and interrelationships for various parameters. Correlation studies showed that biomass per plant, pods per plant, secondary branches per plant, seeds per pod and 100-seed weight were positive and significant at genotypic level but positive and highly significant at phenotypic level. Days to flowering was negative and non-significantly correlated with grain yield per plant at both genotypic and phenotypic levels. Path coefficient showed that 100-seed weight had maximum direct effect on grain yield followed by pods per plant, secondary branches per plant, seeds per pod, days taken to maturity and number of primary branches per plant. The number of days taken to flowering, plant height and biomass per plant had negative direct effects on grain yield.

Key words:
Cicer arietinum, genetic variability, heritability, correlation

Pulses, dry edible seeds of leguminous plants, constitute an important source of balanced human diet throughout the world. Among the pulses, chickpea (*Cicer arietinum* L.) is the third leading grain legume in the world and first in the South Asia. Ninety two per cent of the area and eighty nine per cent of the production of grain are concentrated in semi-arid tropical countries (Anonymous, 1995). Chickpea is the most important rabi pulse crop of Pakistan predominantly grown in vast rainfed area of 1046 thousand hectares with an annual production of 823 thousand tons and an average yield of 786.68 kg/hectares (Anonymous, 2007-2008). Chickpea is the cheapest and readily available source of protein (19.5%), fats (11.4%), carbohydrates (57-60%), ash (4.8%) and moisture (4.9-15.59%), Huisman and Van del poel (1994).

Despite its nutritional values and economic importance, chickpea production is relatively low in the country. This is primarily due to poor genetic makeup of cultivars available. Genetic variability is a prerequisite for any breeding programme, which provides opportunity to a plant breeder for selecting high yielding genotypes.

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The present study was conducted at the department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, during the crop season 2007-2008. The experimental material comprised twenty chickpea genotypes Viz. 698, 818, 810, 4025, 205, 1049, 114, 1205, Pb-2000, 820, 115, 101, 620, 117, 781, 1288 , 5006 and three check varieties i.e., Piadar-91, AUG-27 and CM-98. The genotypes were sown in RCBD with three replications. Genotypic and phenotypic correlation coefficients were calculated (Kown and Torrie., 1964). The estimation of heritability and genetic advance were calculated as described by Falconer, 1989.

Genetic parameters of yield and their components are given in Table 1. In the present study, the greatest genotypic and phenotypic variances were for number of pods per plant (NPP), followed by BM per plant. Genotypic coefficients of variations were relatively greater in GYP (29.265%), HSW (20.757%), BMP (19.146%) and NPP (14.146%) than in other traits, while it was smaller in NDM (1.111%), NDF (1.426%), PH (4.431%), NPB (3.399%), NSB (6.387%), and NSP (5.118%). Similar findings were reported by Adhikari and Pandey (1982). Phenotypic coefficients of variations were the highest in GYP (29.228%), HSW (20.787%), BMP (18.889%) and NPP (14.536%) than in other traits, while it was smaller in NDM (1.813%), NDF (1.847%), PH (4.745%), NPB (5.846%), NSB (7.209%), and NSP (7.118%). The smallest phenotypic coefficient of variation was for NDM. Similar findings were

reported by Dasgupta *et al.* (1992) and Adhikari and Pandey (1982). Broad-sense heritabilities ranged from 37.56% to 99.84%. The heritabilities were low for NDF, NDM, NPB and NSP but the highest values were found for BMP, GYP, HSW, NPP, PH and NSB per plant. The higher value of heritability for grain yield per plant, 100-seed weight 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. 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 NDF, NDM, PH, NPB and NSP. The results indicated that these traits were greatly influenced by the environment (Arshad *et al*., 2002).

Correlation coefficient analysis: The genotypic and phenotypic correlations coefficients of number of days taken to flowering with pods per plant and secondary branches per plant were positive and non-significant (Table 2). A negative but significant association was noted between days taken to flowering and biomass per plant. Other associations were negative and non-significant for days taken to maturity, grain yield per plant, plant height, number of primary branches, and number of secondary branches. A negative and non-significant association between the days to maturity and days taken to flowering, pods per plant, plant height, seeds per pod, and 100-seed weight. Similar results have been obtained by Raval and Dobariya (2003).The genotypic and phenotypic correlations between plant height and number of secondary branches per plant were positive and highly significant (Table 2).

The genotypic and phenotypic correlation coefficients between number of secondary branches per plant, biomass per plant and grain yield per plant were positive and significant. Genotypic correlation between number of secondary branches per plant and seeds per pod was negative but significant. A positive and significant genotypic and phenotypic correlation was found for number of pods per plant with biomass per plant and grain yield per plant but highly significant genotypic correlation with biomass per plant. Pods per plant could be used as selection for yield improvement in chickpea (Chavan *et al.* 1994). A negative and non-significant genotypic and phenotypic correlation was found for number of pods per plant with 100-seed weight.

The genotypic and phenotypic correlation coefficient between 100-seed weight and grain yield per plant was positive and highly significant but positive and significant with biomass per plant. A negative but highly significant correlation of 100-seed weight with seeds per pod at both genotypic and phenotypic levels as reported by Dasgupta *et al.* (1992), Saleem *et al.* (2002) and Menna *et al.* (2006) was also recorded.

Path coefficient analysis: The traits 100 seed weight, pods per plant and secondary branches per plant exhibited significant direct effects on grain yield (Table 3). The direct effect of number of days taken to flowering on grain yield was negative (-0.2034) whereas number of days taken to flowering had a positive indirect effect through plant height, number of secondary branches per plant, biomass per plant, number of pods per plant. However, it exerted negative effects on grain yield per plant via number of days taken to maturity, number of primary branches, seeds per pod and 100-seed weight as by Raval and Dobariya (2003). The direct effect of number of primary branches per plant on grain yield was positive (0.0926) whereas number of primary branches per plant had a positive indirect effects through number of days taken to flowering, number of secondary branches per plant, number of pods per plant, seeds per pod and 100-seed weight. However, it exerted negative effects on grain yield per plant via, number of days taken to maturity, plant height and biomass per plant. The direct effect of number of secondary branches per plant on grain yield was positive (0.5463) whereas number of secondary branches per plant had a positive indirect effect through number of primary branches per plant, number of pods per plant and 100-seed weight. However, it exerted negative effects on grain yield per plant via, number of days taken to flowering, number of days taken to maturity, plant height, biomass per plant and seeds per pod.

The path-coefficients was computed to estimate the contribution of individual characters to the grain yield. Investigations regarding path coefficient showed that 100-seed weight had maximum direct effect on grain yield per plant followed by number of pods per plant, number of secondary branches per plant, seeds per pod, number of days taken to maturity and number of primary branches per plant. The number of days taken to flowering, plant height and biomass per plant had negative direct effects on grain yield. It was concluded that 100-seed weight, number of pods per plant, number of secondary branches per plant, seeds per pod, number of days taken to maturity and number of primary branches per plant are the characters which contribute largely to grain yield per plant.

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Table 1. Estimates of genetic components in chickpea genotypes

Quantitative Traits	Genotypic Variance	Phenotypic Variance	Genotypic coefficient Variation (%)	Phenotypic coefficient Variation (%)	Broad-sense Heritability (h^2)%	Mean Sum of Squares	Means± S.E	Genetic Advance%
Days taken to flowering	2.584	4.331	1.426	1.847	59.59	9.493**	112.650±0.764	2.177
Days taken to maturity	3.138	8.355	1.111	1.813	37.56	14.632**	159.417±1.319	1.907
Plant height	7.848	9.00	4.431	4.745	87.19	24.699**	63.228±0.620	4.592
Primary branches per plant	2.695	5.778	3.993	5.846	46.64	0.112**	4.112±0.101	1.966
Secondary branches per plant	0.355	0.452	6.387	7.209	78.49	1.162**	9.327±0.810	0.926
Biomass per plant	67.860	69.617	19.146	18.889	99.84	205.337**	43.589±0.134	14.614
Pods per plant	162.809	163.995	14.484	14.536	99.27	489.614**	88.097±0.629	22.295
Seeds per pod	4.115	7.959	5.118	7.118	51.70	1.619**	1.253±3.579	2.559
100-seed weight	0.165	0.166	20.757	20.787	99.71	0.496**	1.957±1.267	0.713
Grain yield per plant	34.374	34.428	29.265	29.288	99.81	103.175**	20.034±0.134	10.277

** **Significant at 1 per cent level**

Table 2. Genotypic (G) and phenotypic (P) correlation of various quantitative variables

Character	Correlation	Days taken to Maturity	Plant Height	Primary Branches Per plant	Secondary Branches Per plant	Biomass Per plant	Pods Per Plant	Seeds Per Plant	100-seed Weight	Grain Yield Per plant
Days taken	G	-0.0851	-0.1347	-0.0151	0.0316	-0.2874*	0.1205	-0.0798	-0.2221	-0.2255
to Flowering	P	0.0051	-0.1582	0.0665	0.0132	-0.2177	0.0882	-0.054	-0.1685	-0.1757
Days taken	G		0.0984	-0.172	-0.0992	0.0066	0.0695	0.4938*	0.0017	0.1029*
to Maturity	P		0.0436	-0.2291	-0.1838	0.0466	-0.0006	0.0648	0.2754	0.0097
Plant height	G			0.5522*	0.6726**	0.4719*	0.0944	0.2225*	0.2032	0.3863*
	P			0.3058	0.5409*	0.4218*	0.0906	0.6137	0.1886	0.3598
Primary	G				0.3936**	0.3686*	0.1147	0.4789*	0.2552	0.4253*
Branches/ plant	P				0.4391*	0.2885	0.0869	0.2470	0.1791	0.2921
Secondary	G					0.6147**	0.2026	-0.1587*	0.1796	0.5461*
Branches /plant	P					0.5517*	0.1712	-0.0949	0.1584	0.4834*
Biomass	G						0.3453**	-0.001*	-0.3638	0.3056*
Per plant	P						0.3412*	-0.0033	-0.3627	0.3041*
Pods Per	G							-0.012*	0.5347*	0.7498**
Plant	P							0.0003	0.5280*	0.7411**
Seeds Per	G								0.0437*	05785**
Plant	P								0.2740	0.5771**
100-seed	G									-0.0512**
weight	P									-0.0361**

*** = Significant at 5 and 1 per cent probability level**

Table 3. Direct (in parenthesis) and Indirect effects for different quantitative variables

Variables	Days taken to flowering	Days taken to maturity	Plant Height	Primary branches per plant	Secondary branches per plant	Pods per plant	Biomass per plant	Seeds per pod	100-seed weight	Genotypic Correlation of grain yield
Days taken to flowering	(0.2034)	-0.0069	0.0295	-0.0014	0.0172	0.0673	0.0496	-0.0092	-0.1682	-0.2255
Days taken to maturity	0.0173	(0.0811)	-0.0215	-0.0159	-0.0542	0.0388	-0.0011	0.0571	0.0013	0.1029
Plant height	0.0274	0.0080	(-0.2187)	0.0512	0.3674	0.0528	-0.0814	0.0257	0.1539	0.3863
Primary branches per plant	0.0031	-0.0140	-0.1208	(0.0926)	0.2150	0.0641	-0.0636	0.0554	0.1933	0.4253
Secondary branches per plant	-0.0064	-0.0080	-0.1471	0.0365	(0.5463)	0.1133	-0.1060	-0.0184	0.1360	0.5461
Pods per plant	-0.0245	0.0056	-0.0207	0.0106	0.1107	(0.5591)	-0.0596	-0.0001	-0.2756	0.3056
Biomass per plant	0.0585	0.0005	-0.1032	0.0341	0.3358	0.1930	(-0.1725)	-0.0014	0.4050	0.7498
Seeds per pod	0.0162	0.0400	-0.0487	0.0444	-0.0867	-0.0006	0.0021	(0..1157)	-0.0388	0.0437
100-seed weight	0.0452	0.0001	-0.0445	0.0236	0.0981	-0.2034	-0.0922	-0.0059	(0.7575)	0.7585

* = Significant at 5 and 1 per cent probability level