GENETIC VARIABILITY AND INTERRELATIONSHIP FOR GRAIN YIELD AND ITS VARIOUS COMPONENTS IN CHICKPEA (*CICER ARIETINUM* L.)

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ABSTRACT

A study was carried out in the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan during 2004-2005. Seventeen elite genotypes and three standard varieties of chickpea were evaluated for means and components of variability (genotypic, phenotypic and environmental), heritability (h^2bs), genetic advance and interrelationships (genotypic and phenotypic) for yield and various yield components. The results suggested that increase in days to flowering, days to maturity, number of secondary branches and 100-seed weight might be useful while selecting high yielding genotypes of chickpea. Mean values of 100 seed weight, total weight of plant and seed yield per plant also suggested that chickpea genotypes 119, 109, 108 and 112 may be used as parents in future breeding programme to develop high yielding cultivars.

KEYWORDS: *Cicer arietinum;* genotypes; heritability; agronomic characters; Pakistan.

INTRODUCTION

Chickpea (*Cicer arietinum*) is third grain legume in the world and first in South Asia for its area and production. Ninety two percent of area and 89 percent of production of chickpea is concentrated in semi-arid-tropical countries (1). It has two types i.e. Kabuli and Desi. The former is grown in temperate regions while the latter i.e desi type is grown in semi-arid tropics (14). Chickpea is the most important rabi pulse crop of Pakistan predominantly grown in vast rainfed area which covers about 88 percent of total chickpea area. It is cultivated on 0.986 million hectares with 0.548 million tons production and average yield of 615 kg per hectare (2). 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%) (7).

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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. However, information on association between yield and its various components provides basis for selecting improved varieties (11).

Wahid and Ahmed (18) reported high estimate of genetic coefficient of variability for plant height and seeds per pod. Tripathi (17) and Kumar *et al.* (13) reported high genetic and phenotypic coefficients of variability for pods per plant, 100-seed weight and seed yield per plant. Sial *et al.* (15) examined that genotypic coefficient of variation was lower for all the characters, except plant height, than phenotypic coefficient of variation.

The present study was conducted to gather information on genetic variability and interrelationship for grain yield and its components in chickpea for future breeding programme.

MATERIALS AND METHODS

This study was conducted in the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad during 2004-2005. Seventeen elite genotypes (genotype 101 to 110, 112, 114, 115, 118 to 120 and Aug-27) and three varieties (Bittal-98, Wanhar-2000 and CM-88) were sown in RCBD with three replications. All cultural practices were carried out throughout crop growing season. Three irrigations were applied alongwith one soaking dose. Number of days to flowering was recorded at the appearance of first flower on 50 percent plants. Days taken to maturity were calculated from sowing date to the date when 90 percent plants turned brown and were ready for harvest. At maturity, data were recorded for yield and various components and subjected to statistical analysis (16). Genotypic and phenotypic correlation coefficients were calculated (11). The estimation of heritability and genetic advance were calculated as described by Falconer (6).

RESULTS AND DISCUSSION

Coefficients of variation

Low coefficients of variation were found for days to flowering (1.69%) and maturity (1.07%), primary and secondary branches per plant (6.50 and 5.76%), plant height (7.91%) and seeds per pod (7.09%), while pods per plant (17.18%), total weight of plant (16.55%) and seed yield per plant

(28.21%) had high coefficients of variability in chickpea (Table 1). Phenotypic coefficients of variation were also found lower for days to maturity (1.09%) and days to flowering (2.74%). It was moderate for seeds per pod (8.41), plant height (12.21%), primary and secondary branches per plant (9.43 and 12.67%), 100-seed weight (17.73%), total weight of plant (19.19%), pods per plant (24.48%) and seed yield per plant (33.07%). Genetic coefficients of variability were observed lower for days to maturity (0.79%), days to flowering (2.16%), and seeds per pod (4.51%), while it was moderate for plant height (9.30%), total weight of plant (9.72%), primary and secondary branches per plant (6.83 and 11.28%), 100-seed weight (15.12%), pods per plant (17.43%) and seed yield per plant (17.26%). Low environmental coefficients of variation values were observed for all traits in this study, ranging from 0.76-9.24 percent except total weight of plant (16.65%), pods per plant (17.18%) and seed yield (28.21%) (Table 1). Khan and Sharma (8) reported high genetic coefficient of variation for secondary branches per plant, pods per plant, and seed yield per plant.

Table 1. Genetic parameters for various physiological traits in chickpea.

Traits	CV%	PCV%	GCV%	ECV%	H^2bs	GA%
Days to flowering	1.69	2.74	2.16	1.69	61.9	3.53
Days to maturity	1.07	1.09	0.79	0.76	51.4	1.61
Primary branches per plant	6.50	9.43	6.83	6.50	52.5	0.24
Secondary branches per plant	5.76	12.67	11.28	5.76	79.8	0.98
Plant height (cm)	7.91	12.21	9.30	7.91	58.0	9.16
Pods per plant	17.18	24.48	17.43	17.18	50.7	6.90
Seeds per pod	7.09	8.41	4.51	7.10	28.8	0.06
100-seed weight (g)	9.24	17.73	15.12	9.24	72.8	4.66
Total weight of plant (g)	16.55	19.19	9.72	16.65	25.63	4.06
Seed yield per plant (g)	28.21	33.07	17.26	28.21	27.4	1.91

CV = Coefficient of variation, PCV = Phenotypic coefficient of variation, GCV = Genotypic coefficient of variation, ECV = Environmental coefficient of variation, h^2bs = Broad sense heritability and GA = Genetic advance.

Chickpea genotype 115 took higher number of days to flowering (123.7) followed by 112, CM-88, 105 and 103 genotypes (Table 2). Genotypes 103 and 108 took higher number of days to maturity (166.0) followed by chickpea genotype 106 (165.3). Chickpea genotypes 101 had more number of primary branches per plant as compared to Aug-27, Bittal-98 and CM-88. Genotype 109 and Wanhar-2000 had significantly higher number of secondary branches than all other chickpea genotypes (Table 2).

Table 2. Means of chickpea genotypes for yield and various yield parameters.

Genotype	Days to flowering	Days to maturity	Primary branches / plant	Secondary branches/ plant	Plant height (cm)	Pods/plant	Seeds/ pod	100-seed weight (g)	Total weight of plant (g)	Seed yield/ plant (g)
115	123.7a	163.7abcd	1.90bcd	5.86bcdef	84.43a	26.37efg	1.48abc	19.50cd	50.60abcd	11.47bcde
112	122.3ab	161.7de	2.86bcde	5.83bcde	82.77abc	36.23abcde	1.44abcd	20.40c	53.70abc	16.35a
CM-88	121.7abc	163.0cde	2.90bcd	6.20b	63.23g	30.57cdef	1.60a	18.70cd	39.97cd	12.43bcde
105	121.7abc	164.3abc	2.66def	5.70bcdefg	79.70bcd	28.03defg	1.30c	18.30cde	46.17bcd	9.80bcde
103	119.7abcd	166.0a	2.43f	5.20gh	64.83efg	40.13abc	1.36bc	16.03de	37.70d	11.22bcde
Wanhar-2000	119.3bcde	164.0abcd	2.70def	6.73a	64.10efg	36.03abcde	1.52bc	21.27bc	45.83bcd	14.32abcde
110	119.3bcde	163.7abcd	2.70def	5.23efg	82.70abc	24.20fg	1.51abc	16.10de	45.90bcd	11.05bcde
Aug-27	119.3bcde	163.7abcd	2.43f	5.76bcdef	68.47defg	33.0abcdef	1.43abc	20.90bc	48.03abcd	9.71bcde
108	119.3bcde	166.0a	2.70def	5.30efg	68.33defg	42.47a	1.58ab	24.37b	60.70ab	9.73bcde
107	118.7bcde	163.0bcde	3.16ab	5.90bcd	77.87bcd	27.00efg	1.43abc	21.55bc	46.60bcd	9.75bcde
102	118.7bcdef	161.3cde	2.80cde	5.63bcdefg	70.03defg	19.17g	1.45abc	19.20cd	41.50cd	7.54e
120	118.3bcdef	161.7de	3.06abc	6.07bc	63.60fg	31.90cdef	1.47abc	15.13e	39.97cd	11.45bcde
118	117.3cdef	163.0bcd	2.53ef	4.60h	69.30defg	42.37ab	1.58a	18.47cd	41.80cd	13.95abcde
106	117.0cdef	165.3ab	2.80cde	5.23fg	72.80cdefg	30.83cdef	1.55ab	21.70bc	51.07abcd	12.91bcde
101	116.0def	154.3abc	3.23a	4.53h	78.17bcd	25.13fg	1.49abc	20.93bc	44.20cd	9.29cde
109	115.3efg	164.0abcd	2.80cde	7.07a	84.07ab	37.97abcd	1.62a	20.03c	61.63a	15.04abc
104	115.3fg	164.0abcd	2.63def	5.63cdefg	74.97bcdef	27.97defg	1.36bc	24.47b	42.80cd	14.35abcde
119	115.3fg	163.3bcd	2.70def	5.56defg	71.87cdefg	36.23abcde	1.63a	29.27a	52.03abcd	11.97bcde
114	113.3g	161.7de	2.56def	4.56h	75.43bcde	26.47efg	1.51ab	20.90bc	46.97abcd	12.00bcde
Bittal-98	113.3g	160.3e	2.86bcde	5.66bcdefg	71.63cdefg	31.97bcdef	1.56ab	24.40b	45.63bcd	8.12e

Means sharing letter(s) are non-significant ($P<0.05$).

Chickpea variety CM-88 and genotype 120 had less plant height which is essential character to reduce lodging in crop plants. In case of pods per plant, chickpea genotypes 108, 118 and 103 had more pods per plant than other genotypes. Genotype 119 had higher number of seeds per pod as compared to other genotypes. Genotype 109 excelled in total weight of plant. Genotype 112 had higher seed yield per plant followed by genotype 109 (Table 2). The results suggested sufficient variability among genotypes for days to flowering and maturity, primary and secondary branches per plant, plant height, seeds per plant, seeds per pod, 100-seed weight, total weight of plant and seed yield per plant. Many research workers reported high genotypic variability in chickpea, like Tripathi (17) for pods per plant, Kumar *et al*. (13) and Arun and Ram (3) for 100 - seed weight and Wahid and Ahmed (18) for yield per plant.

Heritability and genetic advance

High heritability estimates (Table 1) were observed for secondary branches (79.8%), 100-seeds weight (72.8%), days to flowering (61.9%), plant height (58.0%) and primary branches (52.5%) with genetic advance of 0.98, 4.66, 3.53, 9.16 and 0.24 percent, respectively. Estimates of heritability were moderate for days to maturity, and pods per plant with genetic advance of 1.61 and 6.90 percent, respectively. Arun and Ram (3) reported high heritability estimates for days to flowering and 100-seed weight. This may be due to different genetic material used and conditions under which experiment was conducted. High heritability estimates were reported by Tripathi (17) and Kumar *et al*. (13) for pods per plant and 100-seed weight. Kumar and Krishna (12) reported that grain yield per plant had poor heritability estimates.

Correlation coefficients

The data (Table 3) revealed that genotypic correlation of seed yield per plant with number of days taken to maturity and number of pods per plant was positive and significant ($P < 0.05$). Phenotypic correlation of seed yield per plant with total weight of plant and number of pods per plant was positive and highly significant ($P<0.01$). Genotypic correlation of 100-seed weight with total weight of plant and number of seeds per pod was positive and significant. Genotypic and phenotypic correlation of 100-seed weight with number of days taken to flowering was negative and significant ($P < 0.05$). Positive and significant genotypic correlation was also found between number of seeds per pod and total weight of plant. Genotypic correlation of number of pods per plant with number of primary branches per plant was

Table-3: Genotypic (r_g) and phenotypic (r_p) correlation coefficients of various character combinations

		NSB	PH	NDF	NDM	TWP	NPP	NSP	HSW	SYP
NPB	r_p	0.220227	0.395317	0.095038	-0.29022	0.044297	-0.53962*	0.212031	-0.01012	-0.25044
	r_p	0.146616	0.071946	0.083836	-0.1603	-0.01283	-0.28868	0.01224	-0.03718	-0.1785
NSB	r_p		0.026174	0.279325	-0.09157	0.319485	0.079263	0.130191	-0.06888	0.12693
	r_p		-0.00801	0.165535	-0.12419	0.214641	0.110775	0.026784	-0.07464	0.18906
PH	r_p			0.144736	-0.09842	0.766859*	-0.42458	-0.36228	0.006011	-0.00753
	r_p			0.110737	0.01518	0.253755*	-0.26906	0.03182	0.033542	-0.00868
NDF	r_p				0.40822	-0.10509	-0.00292	-0.47044	-0.61642*	0.056586
	r_p				0.10532	-0.01757	0.020959	-0.22041	-0.35108*	0.173013
NDM	r_p					0.46032	0.49913*	-0.35793	-0.08412	0.674478*
	r_p					0.04902	0.17274	-0.01213	-0.04069	0.149386
TWP	r_p						0.11233	0.63277*	0.78857*	0.484328
	r_p						0.48305**	0.27255	0.20837	0.616863**
NPP	r_p							0.50207	0.19963	0.720725*
	r_p							0.22044	0.05746	0.636155**
NSP	r_p								0.50125*	0.436125
	r_p								0.23631	0.205722
HSW	r_p									0.35086
	r_p									0.064455

*Significant ($P < 0.05$), **Highly significant ($P \leq 0.01$), NPB = Number of primary branches per plant, NSB = Number of secondary branches per plant, PH = Plant height, NDF= Number of days taken to flowering, NDM = Number of days taken to maturity, TWP = Total weight of plant, NPP = Number of pods per plant, NSP = Number of seeds per plant, , HSW= 100-seed weight, , SYP = Seed yield per plant.

negative and significant, while it was positive and significant with number of days taken to maturity. Phenotypic correlation of number of pods per plant with total weight of plant was positive and highly significant. Genotypic and phenotypic correlation of total weight of plant with plant height was positive and significant (Table 3). Similar results were reported by Deshmukh and Patil (5) that grain yield was positively correlated with pods per plant. Khorgade (10) observed that seed yield per plant had positive and significant association with biological yield per plant and pods per plant. Bakhsh *et al.* (4) found positive and highly significant genetic correlation of grain yield in parental genotypes with pods per plant, 100-seed weight and biological yield per plant. Khedar and Maloo (9) found significant and positively correlation of yield with pods per plant and 100-seed weight.

From the present study, it is concluded that increase in number of secondary branches per plant, 100-grain weight, number of days taken to flowering, number of days taken to maturity and decrease in plant height, number of primary branches per plant are most important traits under irrigated conditions for selecting high yielding genotypes in chickpea.

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