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Estimation of genetic variability and path analysis of grain yield and its components in chickpea (*Cicer arietinum* L.)

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Abstract-This study was carried out to investigate variability parameters and path coefficient analysis in twenty elite chickpea genotypes including three standards. The material was also evaluated for means and components of variability and interrelationships (genotypic and phenotypic) for yield and yield components. The experiment was laid out by using randomized complete block design with three replications. Heritability estimates were maximum for days taken to flowering, days taken to maturity, pods per plant, total weight of plant, secondary branches per plant, plant height, 100-grains weight and grain yield per plant while other characters exhibited moderate heritability. Seed yield was positively correlated with all attributes under study. Investigations regarding path coefficient showed that days taken to flowering had maximum direct influence on seed yield per plant followed by total weight of plant, 100-grains weight, primary branches, and plant height. These are important parameters for selecting maximum yielding genotypes in chickpea.

Index Terms— Genetic variability, Correlation, Heritability, Path analysis, Chickpea, Grain yield, Genotypes

1 Introduction

PULSES , dry edible grains of leguminous plants, constitute an important source of balanced human diet throughout the world. Chickpea (*Cicer arietinum* L.) is important one among pulses in Pakistan. It is cultivated widely as a nutritive crop in different countries within Mediterranean region particularly Span, Turkey, Syria, and Morocco. It ranks third as a valuable pulse crop on globe and first in South Asia for its area and production. Ninety two percent of the area and eighty nine percent of the production of chickpea grain are concentrated in semi-arid tropical countries (Anonymous, 1995). It occupies about 1050 thousand hectares with total production of 571 thousand tones (Anonymous, 2009, 2010). It is cultivated in about 33 countries of central and west Asia, Europe, North and South America, Ethiopia, North Africa, and Australia (Ladizinsky and Alder, 1976; Singh and Ocampo, 1997). In Pakistan chickpea is mostly sown in the vast rainfed area of the country, which covers about 88 % of total chickpea area. In Punjab about 90% gram is cultivated in rainfed areas; the major chickpea production belt is Thal, which consists of the districts of Bhakhar, Mianwali, Layyah, Khushab and parts of Jhang. It is also grown in Potohar, comprising Attock, Rawalpindi, Jehlum and Chakwal districts and thus chickpea plays a dominant role in the agriculture of rainfed areas of the country. It is rich and less expensive source of protein both for human and animals. Cereals are deficient in essential amino acids (lysine and tryptophan) while chickpea is rich in these amino acids and thus makes a balanced food when taken in combination with cereals. Despite its nutritional values and economic importance, the average yield of chickpea is relatively low in the country. This is primarily due to poor genetic makeup of the cultivars available, excessive vegetative growth, low tolerance to diseases and non availability of grains of improved varieties which need immediate attention of the breeders for the evolution of maximum yielding varieties which fulfill the requirements of ever increasing population. Genetic variability is a prerequisite for any breeding program, which provides opportunity to a plant breeder for selecting maximum yielding genotypes. Information on association between yield and its various components provides basis for selecting improved genotypes. Many workers, however, expressed apprehension about total reliance on yield components analysis (Hardwirck and Andrews, 1980). Several new approaches in recent years have therefore, been structured to precisely estimate the exact quantity of different yield parameters. Path analysis is an important statistical tool which gives information to estimate the correlation among various grain yield parameters. It also shows that which parameters affect the yield directly or which takes some other means. The present study was initiated with the prime objective of finding the mutual relationships of different quantitative traits at seedling and maturity levels and also the type and extent of their contribution to grain yield. The studies thus clearly envisage augmenting the relatively scarce information available on these characters which may be profitably exploited in future programs of chickpea improvement. Yaqoob et al. (1990) computed correlations of 6 yield components in 12 genotypes of chickpea and reported that the correlation between grain yield and days taken to maturity was negative. Eser et al. (1991) recorded closest interrelationship between grain yield per unit area and harvest index, 100-grains weight and grains per plant in chickpea. Jahhar and Mane (1991) reported that the correlation was significant in chickpea between grain yield and all yield parameters except plant height. Plant height had negative direct influence on grain yield. Tripathi et al. (1995) evaluated path analysis for 8 traits in 40 diverse varieties of chickpea (*Cicer arietinum* L.). Maximum yield per plant was associated with pods per plant, primary branches per plant and 100-grains weight.

2 Materials And Methods

The experiment was conducted for the estimation of variability parameters, interrelationship and path coefficient analysis for

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Table 1. Genetic parameters for different morphological traits in chickpea

Character	Mean	Var (g)	Var (p)	Var (e)	GCV%	PCV%	ECV%	h^2	G.A
1	118.38	4.3307	5.1458	0.8151	0.02	0.02	0.01	0.842	3.3505
2	160.892	5.4262	6.1247	0.6985	0.01	0.02	0.01	0.886	3.8480
3	2.998	0.0229	0.0666	0.0437	0.05	0.09	0.07	0.344	0.1560
4	9.598	1.3997	1.8696	0.4699	0.12	0.14	0.07	0.749	1.7965
5	45.398	16.8185	18.0431	1.2246	0.09	0.09	0.02	0.932	6.9488
6	63.39	7.0335	7.4263	0.3928	0.04	0.04	0.01	0.947	4.5296
7	1.712	0.0050	0.0108	0.0058	0.04	0.06	0.04	0.460	0.0840
8	43.581	20.2957	28.8681	8.5724	0.10	0.12	0.07	0.703	6.6294
9	20.648	21.1096	21.7137	0.6041	0.22	0.23	0.04	0.972	7.9504
10	14.35	2.7293	3.0828	0.3534	0.12	0.12	0.04	0.885	2.7281

Var (g) = Genotypic variance, Var (p) = Phenotypic variance, GCV% = Genotypic coefficient of variability, PCV% = Phenotypic coefficient of variability, ECV% = Environmental coefficient of variability, h^2 = heritability, G.A = Genetic advance

Table 2. Estimates of genotypic (top figures) and phenotypic (bottom figures) correlation coefficients in chickpea

CORRELATION MATRIX

	1	2	3	4	5	6	7	8	9	10
1. r(g)	1	0.91832*	-0.09012	-0.07500	0.18767	0.03441	0.78915*	0.17903	0.20732	0.21496
r(p)	1	0.85052**	0.03725	0.02311	0.19890	0.05232	0.41078*	0.12155	0.17532	0.21216
2. r(g)		1	0.08304	-0.00290	0.22522	-0.03736	0.62237*	0.09490	0.23876	0.13471
r(p)		1	0.08098	0.01368	0.22521	-0.01968	0.34429	0.10089	0.21511	0.11760
3. r(g)			1	0.46135	0.50986*	0.62061*	0.10749	0.61151*	0.19184	0.51640*
r(p)			1	0.39358*	0.30436	0.37018*	0.08691	0.27101	0.10952	0.30015
4. r(g)				1	0.57632*	0.67645*	-0.23445	0.81851*	0.19059	0.66368*
r(p)				1	0.50403*	0.60002**	-0.10026	0.60425**	0.18161	0.53128**
5. r(g)					1	0.57755*	0.09291	0.78335*	0.41467*	0.77839*
r(p)					1	0.54271**	0.02930	0.62666**	0.39037*	0.72770**
6. r(g)						1	-0.18378	0.83213*	0.19609	0.75772*
r(p)						1	-0.08960	0.68494**	0.18193	0.69545**
7. r(g)							1	-0.01826	0.39076	0.16910
r(p)							1	-0.04146	0.27111	0.08000
8. r(g)								1	0.41305*	0.99031*
r(p)								1	0.33690	0.71369*
9. r(g)									1	0.42888**
r(p)									1	0.40636*

*, ** = Significant at 0.05 and 0.01 probability levels, respectively

1. Days taken to flowering	6. No. of pods per plant
2. Days taken to maturity	7. No. of seeds per pod
3. No. of primary branches /plant	8. Total weight of plant (gm)
4. No. of secondary branches /plant	9. 100-seeds weight (gm)
5. Plant height (cm)	10. Seed yield per plant (gm)

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Table 3. Direct and Indirect effects of different traits on seed yield

	1	2	3	4	5	6	7	8	9
1.	**1.006739**	0.924505	-0.09072	-0.07551	0.188937	0.034639	0.794472	0.180231	0.208721
2.	-0.72905	**-0.7939**	-0.06593	0.0023	-0.1788	0.029659	-0.49409	-0.07534	-0.18955
3.	-0.02916	0.026874	**0.323609**	0.149298	0.164994	0.200835	0.034784	0.197891	0.06208
4.	0.002023	0.0001	-0.01244	**-0.02697**	-0.01554	-0.01824	0.006323	-0.02208	-0.00514
5.	0.02799	0.033589	0.076042	0.085954	**0.149143**	0.086138	0.013857	0.11683	0.061846
6.	-0.01076	0.01168	-0.19402	-0.21148	-0.18056	**-0.31263**	0.057455	-0.26015	-0.0613
7.	-0.22266	-0.1756	-0.03033	0.06615	-0.02621	0.051853	**-0.28215**	0.005152	-0.11025
8.	0.141759	0.075148	0.484222	0.648126	0.620285	0.658917	-0.01446	**0.791841**	0.327072
9.	0.028073	0.032329	0.025976	0.025807	0.056149	0.026551	0.052911	0.05593	**0.135405**

1. Days taken to flowering	6. No. of pods per plant
2. Days taken to maturity	7. No. of seeds per pod
3. No. of primary branches / plant	8. Total weight of plant (gm)
4. No. of secondary branches / plant	9. 100-seeds weight (gm)
5. Plant height (cm)	

seed yield and its parameters in chickpea (*Cicer arietinum* L.) in the research station of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, during the year 2009-2010. The experimental trail comprised seventeen chickpea elite lines (115, 117, 620, 698, 810, 1049, 1081, 1114, 1205, 1283, 1506, 1818, 1821, 1848, 4025, 6205 and PCH-15) and three check varieties (CM-98, Paidar-91 and Pb-2000) of chickpea. These genotypes and varieties were sown under normal conditions. The layout includes three replications under randomized complete block design. The plot dimensions were 4m x 1.2 m with plant to plant distance and line to line distance 15 cm and 30 cm, respectively. Uniform cultural practices were carried out throughout growing season. Interrelationships, estimates of genetic variability and path coefficient analysis of various quantitative parameters like days taken to flowering, days taken to maturity, plant height, total weight of plant, 100-grains weight, pods per plant, grains per pod, primary branches per plant, secondary branches per plant and grain yield per plant were ascertained. Analysis of variance and co-variance for all characters were carried out using the method of Steel et al (1997). Individual comparison of varietals means was accomplished by Duncan's New Multiple Range Test. Genotypic correlation coefficients and phenotypic correlation coefficients of variation were recorded using the formula of Kown and Torrie (1964).Broad sense heritability for all traits under study was computed as a quantitative relation between genotypic variances to phenotypic variances. Phenotypic (rp) and genotypic (rg) correlation coefficient was calculated as outlined by Kwon and Torrie (1964). Standard error for genotypic coefficients of correlation (SE of rg) were calculated according to Reeve (1955). Standard error for genotypic coefficients of correlation (SE of rg) were calculated according to Reeve (1955).

3 Results And Discussion

Variability estimates revealed that genetic variability is significant among the elite lines for the traits under study. The phenotypic coefficients of variation were invariably slightly greater than their corresponding genetic coefficients variation as the environment effect character expression. Heritability estimates were maximum for days taken to flowering, days taken to maturity, pods per plant, total weight of plant, secondary branches per plant, plant height, 100-grains weight and grain yield per plant while other characters exhibited moderate heritability. Heritability for these traits reveals that selection could be more useful for genetic improvement.

Correlation studies showed that the correlation was positive for plant height, total weight of plant, secondary branches per plant and pods per plant. It was significant at genotypic level but maximally significant at phenotypic level. The correlations were positive for days taken to flowering, primary branches per plant, grains per pod, days taken to maturity and 100-grains weight at genotypic and phenotypic levels.

4 Conclusion

From the present studies, therefore, it may be concluded that days taken to flowering, primary branches, total weight of plant, 100-grains weight and plant height are important parameters for selecting maximum yielding genotypes in chickpea.

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