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Interrelationships and Path Analysis of Yield Attributes in Chick Pea (*Cicer arietinum* L.)

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ABSTRACT

A set of 20 chickpea elite genotypes including two check varieties was included in this study. The genotypes showed highly significant differences for all the characters studied. Seed yield per plant was positively and significantly correlated with days to flowering, total weight of plant, number of pods per plant and 100-seed weight both at the genotypic and phenotypic levels. The correlation of number of secondary branches per plant with seed yield was negative and significant. Number of pods per plant had maximum positive direct effect on seed yield. The other traits in the study also exhibited considerable indirect effect on the seed yield through number of pods per plant. It was concluded that number of pods per plant and 100-seed weight could be used as selection criteria to improve the yield.

Key Words: Interrelationships; Path analysis; *Cicer arietinum*; Yield

INTRODUCTION

Chickpea (*Cicer arietinum* L.) or gram plays a dominant role in the agricultural economy of vast rainfed areas of Pakistan. It is grown on an area of 1074.0 thousand hectares with an annual production of 660.7 thousand tons and average seed yield being 615 kg ha^{-1} (Govt. of Pakistan, 2000). Chickpea production in the country has declined drastically during the past few years. It is primarily due to the poor genetic make up of the cultivars and non-availability of good quality seed of varieties with high yield potential and resistance against diseases and insects. Therefore, there is dire need to develop improved cultivars of chickpea.

Information on correlation and path coefficient analysis is of much use to plant breeders for selection and breeding genotypes with increased yield potential. Correlation analysis for seed yield provides opportunity for selection and leads to a directional model based on yield and its components in field experiments. Path coefficient analysis is a technique of statistical analysis specially designed to quantify the interrelationships of different components and their direct and indirect effects on seed yield. The present study is an attempt to determine interrelationships between yield and its components and assess the direct and indirect effects of each component on seed yield.

MATERIALS AND METHODS

The present study was carried out in the department of Plant Breeding and Genetics, University of Agriculture, Faisalabad during the year 2000-2001. The experimental material comprised eighteen advanced lines of chickpea and two check varieties (CM-98 & Paidar-91). The seed were sown in the field on four row plots of 4 m x 102 m size keeping plant to plant and row to row distances 15 cm and 30 cm, respectively. The experiment was laid out in a randomized complete block design with three replications. The data were recorded for days to flowering, days to maturity, plant height (cm), number of primary branches per plant, number of secondary branches per plant, total weight of plant (g), number of pods per plant, number of seeds per pod, 100-seed weight (g) and seed yield per plant (g). Except the enumerated data for days to flowering and days to maturity, ten plants were taken randomly from each genotype in each replication to record the data. The data were subjected to analysis of variance following Steel and Torrie (1980). Genotypic and phenotypic correlations were computed following Kwon and Torrie (1964). Path coefficients were estimated according to Dewey and Lu (1959), where seed yield per plant was kept as resultant variable and other contributing characters as causal variables.

RESULTS

Analysis of variance exhibited highly significant differences among the genotypes for all the characters under study (Table I). Correlation analysis (Table II) revealed that seed yield per plant was positively and significantly correlated both genotypically and phenotypically with days to flowering, total weight of plant, number of pods per plant and 100-seed weight. The strongest correlation of seed yield per plant was recorded with number of pods per plant ($r_g = 0.943$ and $r_p = 0.915$). Negative and significant correlation (genotypic and phenotypic) of seed yield per plant was observed with number of secondary branches per plant. Plant height, number of primary branches per plant and number of seeds per pod were positively yet non-significantly

correlated with seed yield per plant. Negative and non-significant correlation of days to maturity with seed yield per plant was observed. Lokendra *et al*. (1999), Saleem *et al*. (1999) and Tripathi (1998) also reported significant and positive correlation of number of pods per plant and 100-seed weight with seed yield per plant.

Path analysis (Table III) exhibited that all the characters under study except days to maturity, plant height and 100-seed weight had positive direct effect on seed yield per plant. Maximum direct positive effect on seed yield per plant was exerted by number of pods per plant. Other traits except days to maturity and number of secondary branches per plant also had great indirect contribution to seed yield per plant via number of pods per plant. The results corroborate the findings of Tripathi *et al*. (1995), Singh *et al*. (1997) and Yousefi *et al*. (1997) who also reported high positive direct effect of number of pods per plant on seed yield per plant.

DISCUSSION

The results indicated that total weight of plant tended to increase the seed yield per plant. This can be explained on the basis that total weight of plant is the total photosynthetic product that is consumed in seed development that results in higher seed yield. The non-significant correlation of number of pods per plant with the number of seeds per pod can be

Table I. Mean squares of different characters in chickpea genotypes

SOV	DF	DTF	DTM	PH	NPB	NSB	TWP	NPP	NSP	HSW	SYP
Replications	2	1.08*	22.22*	0.84	0.02	0.03	20.63	9.51	0.004	0.12	1.43
Genotypes	19	49.00**	26.75**	71.93**	0.06**	0.44**	84.26**	158.2**	0.020**	6.63**	13.05**
Error	38	2.86	5.15	3.41	0.02	0.17	12.82	16.01	0.007	0.19	1.04

* = Significant at 0.05 probability level; ** = Significant at 0.01 probability level; DTF = Days to flowering; DTM = Days to maturity; PH = Plant height; NPB = Number of primary branches per plant; NSB = Number of secondary branches per plant; TWP = Total weight of plant; NPP = Number of pods per plant; NSP = Number of seeds per pod; HSW = 100-seed weight SYP = Seed yield per plant

Table II. Genotypic (r_g) and phenotypic (r_p) correlation coefficients of various character combinations in chickpea

		DTM	PH	NPB	NSB	TWP	NPP	NSP	HSW	SYP
DTF	r_g	0.115	0.384	0.322	0.005	-0.001	0.444*	-0.246	0.115	0.404*
	r_p	0.087	0.364	0.257	0.007	0.006	0.396*	-0.179	0.104	0.371*
DTM	r_g		-0.130	0.021	0.353	0.198	-0.055	0.262	-0.171	-0.055
	r_p		-0.119	0.029	0.211	0.135	-0.058	0.192	-0.142	-0.063
PH	r_g			0.476*	0.342	0.220	0.450*	-0.157	-0.004	0.176
	r_p			0.372*	0.243	0.200	0.414**	-0.131	-0.010	0.156
NPB	r_g				0.114	0.190	0.209	-0.071	-0.122	0.094
	r_p				0.100	0.214	0.154	-0.028	-0.097	0.084
NSB	r_g					-0.367	-0.606*	-0.117	0.027	-0.784*
	r_p					-0.253	-0.422**	0.004	-0.003	-0.571*
TWP	r_g						0.569*	-0.040	0.118	0.523*
	r_p						0.555**	-0.045	0.110	0.519**
NPP	r_g							0.091	0.418*	0.943*
	r_p							0.097	0.393*	0.915**
NSP	r_g								0.242	0.203
	r_p								0.219	0.169
HSW	r_g									0.528*
	r_p									0.507**

* = Significant at 0.05 probability level; ** = Significant at 0.01 probability level; DTF = Days to flowering; DTM = Days to maturity; PH = Plant height; NPB = Number of primary branches per plant; NSB = Number of secondary branches per plant; TWP = Total weight of plant; NPP = Number of pods per plant; NSP = Number of seeds per pod; HSW = 100-seed weight; SYP = Seed yield per plant

Table III. Direct (bold values) and indirect effects of different characters on seed yield per plant in chickpea

	DTF	DTM	PH	NPB	NSB	TWP	NPP	NSP	HSW
DTF	**0.138**	-0.019	-0.165	0.003	0.001	-0.001	0.481	-0.033	-0.002
DTM	0.016	**-0.165**	0.056	0.001	0.043	-0.016	-0.060	0.036	0.003
PH	0.053	0.021	**-0.429**	0.004	0.042	0.018	0.488	-0.021	0.001
NPB	0.045	-0.004	-0.204	**0.009**	0.014	0.016	0.227	-0.100	0.002
NSB	0.001	-0.058	-0.146	0.001	**0.122**	-0.030	-0.657	-0.016	-0.001
TWP	-0.001	-0.033	-0.094	0.002	-0.045	**0.083**	0.617	-0.006	-0.002
NPP	0.061	0.009	-0.193	0.002	-0.074	0.047	**1.085**	0.012	-0.007
NSP	-0.034	-0.043	0.067	-0.001	-0.014	-0.003	0.099	**0.136**	-0.004
HSW	0.016	0.028	0.002	-0.001	0.003	0.010	0.454	0.033	**-0.017**

DTF = Days to flowering; DTM = Days to maturity; PH = Plant height NPB = Number of primary branches per plant NSB = Number of secondary branches per plant TWP = Total weight of plant NPP = Number of pods per plant NSP = Number of seeds per pod; HSW = 100-seed weight

attributed to the development of empty pods or pods having less number of seeds. The sees that were produced gained good weight consuming available photosynthates in higher quantities, that is why the correlation of 100-seed weight was positive and significant with the seed yield and number of pods per plant. Higher and significant correlation of seed yield with number of pods per plant and 100-seed weight and the highest direct contribution of number of pods per plant to seed yield and great indirect contribution of most of the traits via number of pods per plant suggests that seed yield per plant was dependent on these two traits. More number of pods would produce more seeds and 100-seed weight is an index of seed size. It therefore, suggests that more and heavier seeds would lead towards higher seed yield per plant.

CONCLUSION

Positive and significant association and higher contribution made to seed yield per plant suggested that number of pods per plant and 100-seed weight should be given due emphasis as selection criteria for synthesis of improved genotypes.

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