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Correlation and Path Analysis Studies for Yield and Yield Attributing Traits in Chickpea (*Cicer arietinum* L.)

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A B S T R A C T

The present investigation was executed at the Oilseed Research Station Kalyanpur, C. S. Azad University of Agriculture and Technology Kanpur, Uttar Pradesh, India, during the *rabi* 2018-19 with goal to investigate the correlation among various traits including their direct and indirect effects on seed yield in the fifty chickpea genotypes. Analysis of variance revealed the presence of sufficient variability among the genotypes for all the traits under the study. Correlation studies revealed seed yield per plant had positive and significant association with 100 seed weight (g), number of pods per plant, number of secondary branches per plant and number of seeds per pod, whereas negative and significant association was found with days to maturity. Path analysis revealed direct positive effect of 100 seed weight, number of pods per plant, number of seeds per pod and number of secondary branches per plant and negative effect of days to maturity, harvest index and number of primary branches per plant with seed yield per plant. Selection index traits for increasing seed yield per plant are 100 seed weight (g), number of pods per plant, number of secondary branches per plant and number of seeds per pod.

***Key words*:** Chickpea, Correlation, Direct and indirect effects

Among the pulses, the second most important cool season pulse crop of the world is chickpea (*Cicer arietinum* L.). It occupies a first position among the pulses in the country with maximum area, production and its high nutritive value. It's known to have originated in an area of present-day South-eastern Turkey and adjoining Syria. Chickpea seeds contain on an average of 64% total carbohydrates (47% starch, 6% soluble sugar), 23% protein, 5% fat, 6% crude fibre and 2% ash. It's also reported to contain high mineral content: phosphorus (340mg/100g), calcium (190mg/100g), magnesium (140mg/100g), iron (7mg/100g), zinc (3mg/100gm) [1].

Though India is the largest producer of chickpea crop, because of low productivity it imports 25% of chickpea as compared to countries like Italy, Turkey, Iran, etc. There is a good scope to improve the productivity of this crop by various means like varietal improvement and adopting the improved production technology on larger area of the country. Correlation coefficient is a statistical measure which is used to find out the degree (strength) and direction of relationship between two or more variables. The genotypic and phenotypic paths are commonly estimated to determine yield contributing characters which are useful for plant breeders and geneticists in selection of elite genotypes from diverse genetic population.

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MATERIALS AND METHODS

In the present investigation fifty chickpea genotypes were sown in randomized complete block design (RBD) with three replications at Oil Seed Research Farm Kalyanpur, Chandra Shekhar Azad University of Agriculture and Technology Kanpur (U.P) during *Rabi* 2018-19. Row to row and plant to plant distance was 30 and 10 cm respectively. Data for ten quantitative traits were recorded viz., days to 50% flowering, days to maturity, number of primary branches per plant, number of secondary branches per plant, plant height (cm), number of pods per plant, number of seeds per pod, 100 seed weight (g), seed yield per plant (g) and harvest index (%). Observations for all the traits were recorded on five randomly selected plants from each replication and each block except for days to 50% flowering and days to maturity where the observations were recorded on plot basis. The mean values were used for analysis of variance by fallowing Panse and Sukhatme [2]. Correlation computed as per the methods suggested by Al-Jioburi *et al.* [3] and path coefficient was calculated by employing the method suggested by Dewey and Lu [4].

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among the genotypes for all the characters. This in turn indicated that there was sufficient variability in the material studied, which could be utilized in further breeding programme.

Correlation coefficient studies

The genotypic and phenotypic correlations for yield and its component characters studied are presented in (Table 1). The significant correlations either in positive or negative directions are described. In general, genotypic correlation coefficients were higher than their corresponding phenotypic correlation coefficients indicating the association was largely due to genetic reason.

Seed yield per plant had significant and positive correlation association at both phenotypic and genotypic levels with 100 seed weight (p=0.271**; g=0.291**), number of pods per plant (p=0.223**; g=0.258**), number of secondary branches (p=0.162*; g=0.239**), number of seeds per pod (p=0.166*; g=0.245**) and harvest index (p=0.142*; g=0.168*). While it had significant and negative correlation association with days to maturity (p=-0.466**; g=-0.493**) at both phenotypic and genotypic levels respectively.

Table 1 Estimates of genotypic and phenotypic correlation coefficient among different traits in chickpea

Characters		D50	NPB	NSB	PH	NP	NS	DM	HI	100SW	SYP
D50	G	1.000	-0.191*	-0.109	-0.007	0.054	-0.082	0.300**	-0.012	-0.019	-0.117
	P	1.000	-0.161*	-0.084	-0.009	0.046	-0.077	0.282**	0.002	-0.019	-0.112
NPB	G		1.000	0.549**	0.201*	0.256**	-0.050	0.040	0.102	0.293**	0.065
	P		1.000	0.406**	0.176*	0.216*	-0.048	0.028	0.077	0.267**	0.050
NSB	G			1.000	0.223**	0.531**	0.109	-0.079	0.258**	0.043	0.239**
	P			1.000	0.168*	0.486**	0.093	-0.053	0.196*	0.045	0.162*
PH	G				1.000	-0.114	-0.178*	0.010	-0.002	0.049	0.025
	P				1.000	-0.099	-0.119	0.008	0.001	0.051	0.017
NP	G					1.000	0.166*	-0.212**	0.583**	0.005	0.258**
	P					1.000	0.141*	-0.175*	0.470**	0.007	0.223**
NS	G						1.000	-0.113	0.205*	0.007	0.245**
	P						1.000	-0.086	0.122	0.003	0.166*
DM	G							1.000	-0.450**	-0.066	-0.493**
	P							1.000	-0.399**	-0.063	-0.466**
HI	G								1.000	0.024	0.168*
	P								1.000	0.021	0.142*
100SW	G									1.000	0.291**
	P									1.000	0.271**
SYP	G										1.000
	P										1.000

*Significant at 5% level of significance; **Significant at 1% level of significance

D50 : Days to 50% flowering
NPB : Number of Primary branches per plant
NSB : Number of Secondary branches per plant
PH : Plant height (cm)
NP : Number of pods per plant
NS : Number of seeds per pod
DM : Days to maturity
HI : Harvest index (%)
100SW : 100 seed weight (g)
SYP : Seed yield per plant (g)

Characters viz., harvest index (p=0.470**; g=0.583**), and number of seeds per pod (p=0.141*; g=0.166*) showed positive significant correlation with number of pods per plant. While it had the significant negative relation with days to maturity (p=-0.175*; g=-0.212*) at both phenotypic and genotypic levels respectively. These results clearly indicate that indirect selection for seed yield in chickpea can be based on these traits. 100 seed weight had significant and positive correlation with number of primary branches per plant (p=0.267**; g=0.293**) at both phenotypic and genotypic levels respectively.

Earlier studies too have indicated such positive significant correlation by Dasgupta *et al.* [5] reported that seed yield was significantly and positively correlated with number of pods per plant, harvest index and number of branches per plant, 100 seed weight and seeds per pod. Ali *et al.* [6] reported pods per plant; seeds per pod and 100 seed weight were positive and significantly correlated with biological yield per plant at both phenotypic and genotypic levels. Shah *et al.* [7] observed seed yield per plant was positively and significantly correlated with effective pods per plant, seeds per pod, biological yield per pod, 100 seed weight and harvest index. Similar results were reported by Aktar *et al.* [8], Babber *et al.* [9], Waseem *et al.* [10] reported that significant and positive correlation between yield and 100 seed weight, number of pods plant and plant height.

Path coefficient analysis

Path coefficient analysis was carried out to find out the direct and indirect contribution from each of the character towards seed yield per plant. The phenotypic and genotypic correlation coefficients are partitioned to direct and indirect effects which are presented in (Table 2).

Table 2 Direct (diagonal) and indirect genotypic and phenotypic effects of different characters on grain yield in chickpea

Characters		D50	NPB	NSB	PH	NP	NS	DM	HI	100SW	SYP
D50	P	0.045	0.021	-0.019	-0.000	0.011	-0.015	-0.157	0.003	-0.005	-0.117
	G	0.026	0.009	-0.006	-0.000	0.008	-0.008	-0.133	0.000	-0.005	-0.112
NPB	P	-0.008	-0.113	0.096	0.011	0.054	-0.009	-0.021	-0.027	0.083	0.065
	G	-0.004	-0.057	0.032	0.006	0.035	-0.004	-0.014	-0.010	0.065	0.050
NSB	P	-0.004	-0.062	0.176	0.013	0.112	0.021	0.041	-0.070	0.012	0.239**
	G	-0.002	-0.022	0.083	0.006	0.083	0.009	0.028	-0.030	0.012	0.162*
PH	P	-0.000	-0.022	0.039	0.058	-0.024	-0.034	-0.005	0.000	0.013	0.025
	G	-0.000	-0.009	0.014	0.037	-0.017	-0.012	-0.004	0.000	0.012	0.017
NP	P	0.002	-0.029	0.093	-0.006	0.211	0.032	0.111	-0.158	0.001	0.258**
	G	0.001	-0.012	0.040	-0.003	0.171	0.014	0.085	-0.070	0.002	0.223**
NS	P	-0.003	0.005	0.019	-0.010	0.034	0.193	0.059	-0.055	0.002	0.245**
	G	-0.002	0.002	0.007	-0.004	0.024	0.106	0.042	-0.016	0.000	0.166*
DM	P	0.013	-0.004	-0.013	0.001	-0.044	-0.021	-0.525	0.121	-0.018	-0.493**
	G	0.007	-0.001	-0.005	0.000	-0.030	-0.009	-0.475	0.060	-0.015	-0.466**
HI	P	-0.001	-0.011	-0.045	-0.000	0.122	0.039	0.236	-0.271	0.006	0.168*
	G	0.000	-0.004	0.016	0.000	0.080	0.011	0.190	-0.150	0.005	0.142*
100SW	P	-0.001	-0.033	0.007	0.002	0.001	0.001	0.034	-0.006	0.283	0.291**
	G	-0.001	-0.014	0.004	0.001	0.001	0.000	0.028	-0.003	0.252	0.271**

Residual Effect = 0.66535. Underlined figures indicate direct effect
*Significant at 5% level; **Significant at 1% level of probability

D50 : Days to 50% flowering
NPB : Number of Primary branches per plant
NSB : Number of Secondary branches per plant
PH : Plant height (cm)
NP : Number of pods per plant
NS : Number of seeds per pod
DM : Days to maturity
HI : Harvest index (%)
100SW : 100 seed weight (g)
SYP : Seed yield per plant (g)

Among all the components 100 seed weight exhibited the highest direct effect (p=0.252; g=0.283) on seed yield followed by number of pods per plant (p=0.171; g=0.211), number of seeds per pod (P=0.106; g=0.193), secondary branches per plant (p=0.083; g=0.176), plant height (p=0.037; g=0.058) and days to 50% flowering (p=0.026; g=0.045) while days to maturity (p=-0.475; g=-0.525), harvest index (p=-0.150; g=-0.271) and number of primary branches per plant (p=-0.057; g=-0.113) recorded negative direct effect at both phenotypic and genotypic levels respectively. Number of pods per plant had positive indirect effects through days to maturity (p=0.085; g=0.111), number of secondary branches per plant (p=0.040; g=0.093), number of seeds per pod (p=0.014; g=0.032), days to 50% flowering (p=0.001, g=0.002), 100 seed weight (p=0.002; g=0.001) and it had negative indirect effect through harvest index (p=-0.070; g=-0.158), number of primary branches per plant (p=- 0.012; g=-0.029) and plant height (p=-0.003; g=-0.006) at both phenotypic and genotypic level respectively.

100 seed weight (g) had positive indirect effect through days to maturity (p=0.028; g=0.034), number of secondary branches per plant (p=0.004; g=0.0076), plant height (p=0.001; g=0.002), number of seeds per pod (p=0.000; g=0.001), number of pods per plant (p=0.001; g=0.001) and it had negative indirect effect through number of primary branches per plant (p=-0.014; g=-0.033), harvest index (p=-0.003; g=-0.006) and days to 50% flowering (p=-0.001; g=-0.001) both at phenotypic and genotypic level.

The residual effect in this path was positive and high. It indicates that some more characters may also be included in the study (0.6653). Number of pods per plant, 100 seed weight, plant height, days to 50% flowering had high

positive direct effect on seed yield as reported by [11]. Farshadfar [12] revealed pod number with, seed number, 100 seed weight had highest direct effect on seed yield. Mushtaq *et al.* [13] reported that days 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. Borate and Dalvi [14] noted that number of pods per plant and number of primary branches had highest direct positive effect on seed yield, followed by dry matter per plant. Mishra and Babbar [15] reveled that highest direct effect on seed yield was contributed by number of effective pods per plant. Jhadav *et al.* [16] found that highest positive direct effect exhibited by branches per plant, followed by 100 seed weight, harvest index and number of pods per plant on seed yield at both genotypic and phenotypic level.

CONCLUSION

The traits 100 seed weight, number of pods per plant, number of secondary branches per plant and number of seeds per pod recorded highly positive significant correlation association and high direct effect on seed yield per plant. Hence, these traits should be considered for constructing plant type for the enhancement of yield.

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