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Short Communication

Correlation and path analysis studies in chickpea (*Cicer arietinum* L.) for seed yield and its attributes in the Himalayan region

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ABSTRACT

Correlation and path coefficient analysis was done with 25 chickpea accessions to find out association among characters and to assess the direct and indirect effects of eleven characters on seed yield. The study was conducted during *rabi* 2016-17. Correlation studies indicated that seed yield per plant exhibited a significant positive association with plant height, number of secondary branches, number of pod per plant, biomass yield and 100-seed weight. Path analysis revealed that the trait number of pod per plant had highest positive direct effect followed by 100-seed weight, days to 75% flowering, biomass yield and number of seeds per pod. Traits like number of secondary branches per plant, plant height and number of seed per pod contributed to seed yield mainly through indirect effects *via* the trait number of pods per plant. Hence, selection for high number of pods per plant and 100-seed weight would lead to high seed yield. Selection for number of secondary branches per plant, plant height and number of seed per pod would facilitate selecting genotypes for the high number of pods per plant.

Key words: Chickpea, Correlation, Himalayan region, Path Analysis

Chickpea (*Cicer arietinum* L. 2n=2x=16) belongs to genus *Cicer,* family Fabaceae, and sub family papilionacea. It is an annual, self-pollinating, diploid pulse crop with a genome size of 750Mbp. It is an important winter pulse crop of India and has a significant contribution to pulse economy. This crop occupies an indispensable place in our daily diet as a very good source of protein, fits well in cropping system and tolerates drought. Seed yield being the most important and polygenically controlled complex character, hence is not an efficient character for selection. The correlation coefficient between various dependent and independent variables helps to obtain best combinations of attributes in chickpea crop for crop improvement programmes. Correlation studies do not clearly reveal such sort of information and knowledge about interrelationships of heritable traits that may lead to negative results. On the other hand, partitioning of total correlation into direct and indirect effects by path analysis helps in making the selection more effective. Path analysis provides the direct and indirect effects of different yield component characters on seed yield thus aids in getting high selection response simultaneously for several characters. Hence the present investigation was done to study the association between the characters and the direct and indirect effects of yield components on seed yield per plant in chickpea

The present experimental material consists of twenty five genotypes of chickpea accession collected from ICRISAT and Department of Crop Improvement, CSK HPKV, Palampur. The experiment was laid out in Randomized completely block design (RCBD) with three replication during *rabi* 2016-17 at Crop Improvement Experiment Farm, CSK HPKV, Palampur. Each genotype was sown in two rows of ridges and furrows. Row-to-row and plant-to-plant spacing was maintained at 30 and 10cm respectively. Data was generated on five randomly picked competitive plants and observations were recorded on agronomic traits like days to 50% flowering, days to 75% flowering, Plant height (cm), number of primary branches, number of secondary branches, number of nodes per plant, number of pod per plant, number of seed per pod, biomass yield (g), harvest index, 100-seed weight, and seed yield per plant. The coefficient of correlations was computed as per the method suggested by Al-Jibourie *et al.* (1958) and path coefficient was analyzed by employing the method suggested by Dewey and Lu (1959).

In the present investigation, the traits like plant height (0.323), number of secondary branches (0.587), number of pods per plant (0.835), biomass yield (0.320) and 100-seed weight (0.352) recorded significant positive correlation with seed yield per plant. These characters can be given importance during selection to improve the yield potential of chickpea (Table 1). This was in accordance with the findings of Sharma *et al.* 1999 and Jeena and Arora 2001. Among these characters; number of pods per plant (0.835) had the highest positive correlation with seed yield per plant, indicating the fact that selection of genotype for this trait would also target genotypes with high seed yield capacity. Harvest index (-0.398) revealed significant negative correlation indicating no association. Similar findings were reported by Arshad *et al.* 2004 in chickpea.

Days to 50% flowering exhibited a positive association with Days to 75% flowering (0.982). Plant height had a significant positive association with number of nodes per plant (0.802) and number of pods per plant (0.356).

Number of primary branches had a positive association with number of secondary branches (0.433) and 100-seed weight (0.545). Number of secondary branches showed a positive association with a number of pod per plant (0.714). Number of nodes per plant exhibited a positive association with yield biomass (0.470). Harvest index had a positive and significant association with a number of nodes per plant (0.405), number of seeds per pod (0.697) and yield biomass (0.419). The results revealed a strong inter trait correlation, which paves way for improvement of these characters through simple selection techniques.

The significant negative correlation was revealed by 100-seed weight with days to 50% flowering (-0.305), days to 75% flowering (-0.426), number of nodes per plants (-0.405), number of seeds per pod (-0.695) and harvest index (-0.507). Harvest index had a negative association with number of secondary branches (-0.490) and number of pods per plant (-0.252). Yield biomass had a negative association with days to 75% flowering (-0.227). Number of primary branches recorded negative association with a number of seeds per pod (-0.251), days to 50% flowering (-0.357) and days to 75% flowering (-0.362). In this case, there was a negative association between agronomically important traits. This hinders the progress of improvement to isolate genotypes with an optimum expression of aforesaid characters.

Path coefficient analysis provides information regarding direct and indirect effects caused by independent variables having positive correlation with dependent variable like yield. (Table 2). A combination of direct and indirect selection will be effective to get high selection response. The positive direct effect on seed yield was revealed by days to 75% flowering (0.3658), plant height (0.1131), number of primary branches (0.1208), number of pods per plant (1.0033), number of seeds per pod (0.2197), yield biomass (0.3371) and 100-seed weight (0.5577) which depicted a true character association and the selection based on these traits would be highly desirable. Among these traits number of pod per plant (1.0000) exerted a highest positive direct effect. While selecting for high seed yield per plant, the main emphasis should be given to these characters. A similar finding was reported by Tyagi *et al.* 1982, Bhambota 1994, Alam *et al.* 2005 and Renukadevi and Subbalaxmi, 2006 in chickpea.

Negative direct effect on seed yield was observed for days to 50% flowering (-0.1816), number of secondary branches (-0.3664), number of nodes per plant (-0.2659) and harvest index (-0.2084). These negative direct effects were compensated by other traits with positive indirect effects. For instance, number of secondary branches (-0.3664) which had the highest direct negative effect was compensated by the positive indirect effect of plant height (0.0104), number of nodes per plant (0.0540), number of seeds per pod (0.0353), yield biomass (0.0425) and harvest index (0.1795).

Positive indirect effect on seed yield per plant is number of secondary branches (0.7161) via number of pods per plants followed by days to 50% flowering (0.3593) via days to 75% flowering. Plant height (0.357) had a positive indirect effect via number of pods per plant, whereas for the trait number of primary branches (0.3040) it was via 100-seed weight. Number of seeds per pod (0.2834) had a positive indirect effect via number of pods per plant.

The significant positive association and higher direct effect on seed yield per plant suggest that selection should be oriented towards the traits number of pod per plant, number of secondary branches, 100-seed weight, days to 75% flowering and days to 50% flowering. These traits had highest positive direct and indirect effects via other traits on the seed yield per plant. Highly significant and positive association among the various yield-attributing traits indicate immense scope for the seed yield improvement in chickpea.

Table 1. Correlation coefficients among the twelve characters in chickpea

Character	D50	D75	PH	NPB	NSB	NNP	NPP	NSP	BY	HI	100SW	SYP
D50												
D75	0.982**											
PH	-0.078NS	-0.119NS										
NPB	-0.357**	-0.362**	0.065NS									
NSB	0.151NS	0.117NS	-0.028NS	0.433**								
NNP	-0.040NS	-0.005NS	0.802**	-0.251*	-0.147NS							
NPP	0.136NS	0.099NS	0.356**	-0.001NS	0.714**	0.274*						
NSP	0.211NS	0.208NS	0.282*	-0.429**	-0.096NS	0.094NS	0.282*					
BY	-0.211NS	-0.227*	0.241*	-0.127NS	-0.116NS	0.470**	0.197NS	0.218NS				
HI	-0.135NS	-0.077NS	-0.038NS	-0.109NS	-0.490**	0.405**	-0.252*	0.697**	0.419**			
100SW	-0.305**	-0.426**	-0.133NS	0.545**	0.165NS	-0.405**	-0.119NS	-0.695**	-0.108NS	-0.507**		
SYP	0.051NS	-0.064NS	0.323**	0.157NS	0.587**	-0.002NS	0.835**	0.072NS	0.320**	-0.398**	0.352**	

** Significance at 1% and * Significance at 5%

Abbreviation: D50=Days to 50% flowering, D75=Days to 75% flowering, PH=Plant height (cm), NPB=Number of Primary branches, NSB=Number of Secondary branches, NNP=Number of nodes per plant, NPP=Number of pod per plant, NSP=Number of seed per pod, BY=Biomass Yield, HI=Harvest Index, 100SW=100-Seed weight (g), SYP=Seed yield per plant

Table 2. Path analysis depicting direct and indirect effects of eleven characters on seed yield per plant

Character	D50	D75	PH	NPB	NSB	NNP	NPP	NSP	BY	HI	100SW	Correlation with SYP
D50	**-0.1816**	0.3593	-0.0088	-0.0431	-0.0553	0.0105	0.1367	0.0463	-0.0710	0.0281	-0.1701	0.0512
D75	-0.1784	**0.3658**	-0.0135	-0.0437	-0.0429	0.0013	0.0995	0.0458	-0.0764	0.0161	-0.2378	-0.0642
PH	0.0141	-0.0436	**0.1131**	0.0079	0.0104	-0.2133	0.3570	0.0621	0.0811	0.0079	-0.0739	0.3227
NPB	0.0648	-0.1324	0.0074	**0.1208**	-0.1588	0.0666	-0.0010	-0.0942	-0.0427	0.0226	0.3040	0.1572
NSB	-0.0274	0.0428	-0.0032	0.0523	**-0.3664**	0.0392	0.7161	-0.0212	-0.0391	0.1021	0.0920	0.5872
NNP	0.0072	-0.0018	0.0907	-0.0303	0.0540	**-0.2659**	0.2749	0.0207	0.1585	-0.0843	-0.2258	-0.0020
NPP	-0.0247	0.0363	0.0402	-0.0001	-0.2615	-0.0729	**1.0000**	0.0621	0.0664	0.0525	-0.0664	0.8351
NSP	-0.0383	0.0762	0.0319	-0.0518	0.0353	-0.0250	0.2834	**0.2197**	0.0737	-0.1453	-0.3878	0.0720
BY	0.0382	-0.0829	0.0272	-0.0153	0.0425	-0.1250	0.1976	0.0480	**0.3371**	-0.0874	-0.0602	0.3199
HI	0.0245	-0.0282	-0.0043	-0.0131	0.1795	-0.1076	-0.2527	0.1532	0.1413	**-0.2084**	-0.2826	-0.3984
100SW	0.0554	-0.1560	-0.0150	0.0659	-0.0605	0.1076	-0.1195	-0.1527	-0.0364	0.1056	**0.5577**	0.3521

Residual effects = -0.04893.

Abbreviation: D50=Days to 50% flowering, D75=Days to 75% flowering, PH=Plant height (cm), NPB=Number of Primary branches, NSB=Number of Secondary branches, NNP=Number of nodes per plant, NPP=Number of pod per plant, NSP=Number of seed per pod, BY=Biomass Yield, HI=Harvest Index, 100SW=100-Seed weight (g), SYP=Seed yield per plant

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