Correlation, Direct and Indirect Effect Studies of Different Characters on Seed Yield of Chickpea (Cicer arietinum L.) at Satna District of M.P.

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Abstract:

Twenty diverse cultivars of chickpea (Cicer arietinum L.) grown under Completely Randomized block design (CRBD) at AKS University, District- Satna, M.P. during Rabi season on November 2020. The eleven quantitative characters studied for the estimation of correlation and path coefficient analysis. The results was revealed that biological yield per plant (g.), number of secondary branches per plant, number of primary branches per plant, days to 50 percent flowering, days to maturity, plant height (cm.) and number of pods per plant showed high positive significant correlation with seed yield per plant at both genotypic and phenotypic levels, respectively. These features become the most important factors affecting chickpea seed yield. On the basis of path coefficient analysis showed that biological yield per plant (g.), days to maturity and number of pods per plant were important characters that could be taken into consideration for selection and improvement of seed yield in chickpea.

Keywords: Chickpea, Correlation and Path Coefficient.

Introduction:

Pulse crops occupy premier position in agriculture economy of India. They are the very important source of dietary proteins in the diets of vegetarian who belongs to developing or developed countries and green nutritious fodder or feed for livestock. The legume crops helps in atmospheric nitrogen fixation in soil and increase the soil fertility (Ali, 2007).

Bengal gram is the third most produced pulse in the world with a total production of 11.6 tons, 80% of which is desi chana and 20% is Kabuli chana (Merga and Haji, 2019). It is generally grown in soil under rain-fed conditions during the Rabi season (Shiyani et al., 2001). Chickpea crop is grown in limited available moisture through their tap root system and also help in improving physical properties of the soil. Chickpea also known as garbanzo bean belongs to Cicer genus, species arietinum of Papilionaseae subfamily of Leguminosae, also known as Fabaceae family (Bentham and Hooker, 1862–1883). It originated in southeast turkey.

Bengal gram are abundant in lysine and arginine but smidgen in sulfur-containing amino acids such as cysteine and methionine (Jukanti et al., 2012).The chickpea flower has five petals (one standard is exterior and the largest, two wings are lateral ones, and the two keels are the smallest and innermost). It has ten stamens in (9+1) diadelphous condition with superior ovary.

The primary gene pool of C. arietinum includes C. echinospermum and C. reticulatum. C. reticulatum is also known as putative wild ancestor. The second nearest group is including C bijugum, C. judaicum and C. pinnatifidum. The most distant groups include C. yamashitae, C. chorassanicum, and C. cuneatum (Ohri, 2016).

Knowledge of correlation of various characters on seed yield is of high importance for simultaneous improvement of one trait through selection on the basis of other trait. According to Dewey and Lu, (1959) path coefficient analysis partition the correlation coefficient into direct and indirect effect that enables the breeders to choose the most valuable characters on the basis of genetic effects on seed yield. Work on correlation and path coefficient analysis in chickpea has been done by several workers (Bahl et al., 1976; Ram et al., 1980; Yadav et al., 2002; Singh et al., 2007). However, path coefficient analysis assist to actuate the direct impact of the feature and its indirect contribution from other features. (Singh et al. 1990). Many chickpea breeders have published studies on the correlation coefficients between yield and its components and the direct and indirect effects of various crop plants traits on yield and its components.

Material and methods:

The present investigation was conducted during Rabi, 2020-21 at Research farm, Genetics and Plant Breeding, AKS University, Sherganj, Satna, Madhya Pradesh. The material consists 20 varieties/strains of chickpea (Cicer arietinum L.) germplasm comprising indigenous genotypes, evaluated in Completely Randomized Block Design. The entire experimental field divided in 3 blocks of equal size and each block had 20 plots. Each plot was consisted of four rows 1.2 meters length, following row to row spacing of 30 cm. and plant to plant spacing of 10 cm. Recommended cultural practices were applied to raise a good crop.

Eleven observations on yield and yield contributing characters were recorded. In each plot, five competitive plants were randomly selected for recording observations for all the twelve quantitative characters, which were recorded on the plot basis.

The analysis of variance for the design of the experiment was carried out according to the procedure outlined by (Panse and Sukhatme, 1967). The simple correlations between different characters at genotypic and phenotypic levels were worked out between characters as suggested by (Searle, 1961). Path coefficient analysis was carried out by formula suggested by (Dewey & Lu, 1959).

Result and discussion

The analysis of variance for the design of the experiment involving 20 chickpea strains/varieties were evaluated in Randomized Block Design with three replications for the twelve quantitative characters expressed in **Table 1.** The design of the experiment indicated highly significant differences for all the evaluated characters. The maximum variances due to replication were found for number of pods per plant (83.35) and highest variances due to treatment for plant height (769.74**).. Non-significant differences due to replications were

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observed for all the characters. Similar results were reported by Mushtaq et al. (2013), and Dumbre et al. (1884) in their respective studies.

In the present investigation correlation coefficient was worked out at genotypic and phenotypic levels for all the nine traits and has been presented in Table 2. This indicated that though there was a strong inherent association between the different traits studied, phenotypic expression of the correlation was depressed under the influence of environment. The direction of genotypic and phenotypic correlation was similar for almost all the characters. In general, genotypic correlation was higher than phenotypic ones in magnitude for all the characters except correlation between number of secondary branches per plant and hundred seed weight (g.) and biological yield per plant (g.) and seed yield per plant (g.).

Days of 50% flowering showed significant positive correlation with days to maturity (0.8365** and 0.7963**), number of secondary branches per plant (0.7716** and 0.5017*), and number of primary branches per plant (0.7645** and 0.475*) at both genotypic and phenotypic levels, respectively. Length of pod (cm.) exhibited significant positive correlation with plant height (cm.) (0.5968** and 0.5393*) at both genotypic and phenotypic levels, respectively. This traits was also exhibited negative but significant correlation with number of seeds per pod (-0.5497* and -0.415) at genotypic level, only.

Days to maturity exhibited significant positive correlation with number of secondary branches per plant (0.9345** and 0.6425**), and number of primary branches per plant (0.8705** and 0.5943**) at both genotypic and phenotypic levels, respectively. Number of primary branches per plant showed high significant positive correlation with number of secondary branches per plant (0.9555** and 0.6819**), and seed yield per plant (g.) (0.7479** and 0.4562*) at both genotypic and phenotypic levels, respectively.

Number of secondary branches per plant showed significant positive correlation with seed yield per plant (g.) (0.9746** and 0.5819**), number of pods per plant (0.9454** and 0.7099**) and biological yield per plant (g.) (0.8713** and 0.5827**) and at both genotypic and phenotypic levels, respectively. Plant height exhibited positive significant correlation with hundred seed weight (g.) (0.5923** and 0.5595**) at both genotypic and phenotypic levels, respectively.

Number of pods per plant showed high positive significant correlation with seed yield per plant (g.) (0.5882** and 0.4629*) and biological yield per plant (g.) (0.5631** and 0.465*) at both genotypic and phenotypic levels, respectively. Biological yield per plant (g.) showed high positive significant correlation with seed yield per plant (g.) (0.9328** and 0.9998**) at both genotypic and phenotypic levels, respectively.

Biological yield per plant (g.), number of secondary branches per plant, number of primary branches per plant, days to 50 percent flowering, days to maturity, plant height (cm.) and number of pods per plant showed high positive significant correlation with seed yield per plant at both genotypic and phenotypic levels, respectively. Similarly the results are accordance to (Kandwal et al., 2022; Meena et al., 2021; Farshadfar et al., 2013; Mushtaq et al., 2013; Yucel et al., 2010; Malik et al., 2010; Singh, 2007; Meena et al., 2006 and Renukadevi and Subbalakshmi, 2006) in their respective studies.

Path coefficient analysis helps in understanding the magnitude of direct and indirect contribution of each character on the dependent character like grain yield. Partitioning of correlation coefficient into direct and indirect effects provides the information about the nature and magnitude of effects of other characters on grain yield. The genotypic and phenotypic correlation coefficient of seed yield with the remaining characters under study were further partitioned into direct and indirect effects using path coefficient analysis and are presented in Table 3 and 4 and Figure 1 and 2.

Path coefficient analysis revealed that biological yield per plant (g.) (1.1157) followed by days to maturity (0.3053), number of pods per plant (0.1655), hundred seed weight (g.) (0.0599) and length of pod (cm.) (0.0454) had exerted maximum direct effect on seed yield at genotypic level. Number of primary branches per plant (-0.2145) followed by days to 50 percent flowering (-0.1516), number of seeds per pod (-0.1301), plant height (cm.) (-0.1238) and number of secondary branches per plant (-0.0804) had exhibited negative direct effect on seed yield at genotypic level.

At phenotypic level, path coefficient analysis revealed that biological yield per plant (1.0058) followed by number of secondary branches per (0.0124) and number of primary branches per plant (0.0005) had exerted maximum direct effect on seed yield. Number of pods per plant (-0.0158) length of pod (-0.0136), number of seeds per pod (-0.0098), hundred seed weight (-0.0071), plant height (-0.002), days to 50 percent flowering (-0.0019) and days to maturity (-0.0009) had exhibited negative direct effect on seed yield at phenotypic level.

On the basis of path coefficient analysis showed that biological yield per plant (g.), days to maturity and number of pods per plant were important characters that could be taken into consideration for selection and improvement of seed yield in chickpea. Jyothi et al. (2022); Vikram et al. (2022); Parhe et al. (2014); Alipoor et al. (2013); Ali et al. (2011); Ali and Ahsan (2011); Saleem et al. (2002); Talebi et al. (2007); Arora et al. (2003); Raval and Dobariya (2003); and Toker and Cagirgan (2003) also reported that biological yield, harvest index and many more other quantitative characters were the most important characters contributing highest positive direct effect as well as indirect effect through other traits on seed yield.

Conclusion

In the light of above findings it may be concluded that wide spectrum of exploitable variability in the material studied with respect to seed yield per plant and its component characters. Biological yield per plant (g.), number of secondary branches per plant, number of primary branches per plant, days to 50 percent flowering, days to maturity, plant height (cm.) and number of pods per plant showed high positive significant correlation with seed yield per plant at both genotypic and phenotypic levels, respectively. These features become the most important factors affecting chickpea seed yield. On the basis of path coefficient analysis showed that biological yield per plant (g.), days to maturity and number of pods per plant were important characters that could be taken into consideration for selection and improvement of seed yield in chickpea.

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Table 1 Analysis of variance for eleven quantitative characters in Chickpea.

S. No.	Traits	Replicate (df=2)	Treatments (df=19)	Error (df=38)
1	Days to 50 percent flowering	17.131	641.228**	22.107
2	Length of pod	0.238	0.686**	0.115
3	Days to maturity	8.843	172.489**	11.85
4	Number of primary branches per plant	4.402	1.29**	0.743
5	Number of secondary branches per plant	21.681	14.484**	7.238
6	Plant height	1.830	769.743**	8.5
7	Number of pods per plant	83.359	257.999**	97.493
8	Number of seeds per pod	0.047	0.237**	0.054
9	Hundred seed weight	0.527	45.036**	4.425
10	Biological yield per plant	66.373	652.32**	33.56
11	Seed yield per plant	64.425	163.408**	32.543

*Significant at 5% probability level.

**Significant at 1% probability level.

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Table 2 Genotypic and Phenotypic correlation coefficient for 11 quantitative traits in chickpea.

Traits		Days to 50 percent flowering	Length of pod (cm.)	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	Hundred seed weight (g.)	Biological yield per plant (g.)	Seed yield per plant (g.)
Days to 50 percent flowering	Gen	1.000	0.358	0.8365**	0.7645**	0.7716**	0.5392*	0.355	-0.5133*	0.5931**	0.5881**	0.6444**
	Phe	1.000	0.319	0.7963**	0.475*	0.5017*	0.5308*	0.250	-0.405	0.5487*	0.557**	0.5548**
Length of pod (cm.)	Gen		1.000	0.387	0.4465*	0.4473**	0.5968**	-0.160	-0.5497*	0.386	0.355	0.368
	Phe		1.000	0.334	0.310	0.258	0.5393*	-0.092	-0.415	0.333	0.323	0.316
Days to maturity	Gen			1.000	0.8705**	0.9345**	0.402	0.327	-0.197	0.307	0.5752**	0.6243**
	Phe			1.000	0.5943**	0.6425**	0.384	0.281	-0.183	0.271	0.5449**	0.544*
Number of primary branches per plant	Gen				1.000	0.9555**	0.321	0.4833*	-0.4643*	0.241	0.6902**	0.7479**
	Phe				1.000	0.6819**	0.220	0.344	-0.342	0.165	0.454	0.4562*
No. of secondary branches per plant	Gen					1.000	0.4445*	0.9454**	-0.022	0.078	0.8713**	0.9746**
	Phe					1.000	0.311	0.7099**	-0.087	0.129	0.5827**	0.5819**
Plant height (cm.)	Gen						1.000	0.130	-0.5612**	0.5923**	0.5318*	0.563**
	Phe						1.000	0.096	-0.4787*	0.5595**	0.5225*	0.5181*

Number of pods per plant	**Gen**							**1.000**	**0.072**	**-0.385**	**0.5631****	**0.5882****
	Phe							**1.000**	**0.004**	**-0.244**	**0.465***	**0.4629***
Number of seeds per pod	**Gen**								**1.000**	**-0.641****	**-0.071**	**-0.072**
	Phe								**1.000**	**-0.5297***	**-0.065**	**-0.066**
Hundred seed weight (g.)	**Gen**									**1.000**	**-0.066**	**-0.104**
	Phe									**1.000**	**-0.034**	**-0.038**
Biological yield per plant (g.)	**Gen**										**1.000**	**0.9328****
	Phe										**1.000**	**0.9998****
Seed yield per plant (g.)	**Gen**											**1.000**
	Phe											**1.000**

***Significant at 5% probability level.**

****Significant at 1% probability level.**

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Table 3 Direct and indirect effect for different characters on seed yield per plant at genotypic level in chickpea.

S.N.	Trait	Days to 50 percent flowering	Length of pod (cm.)	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	Hundred seed weight (g.)	Biological yield per plant (g.)	Seed yield per plant (g.)
1	Days to 50 percent flowering	**-0.1516**	-0.0542	-0.1268	-0.1159	-0.117	-0.0818	-0.0538	0.0778	-0.0899	-0.0892	0.6444**
2	Length of pod (cm.)	0.0162	**0.0454**	0.0176	0.0203	0.0203	0.0271	-0.0073	-0.025	0.0175	0.0161	0.368
3	Days to maturity	0.2554	0.1181	**0.3053**	0.2657	0.2853	0.1226	0.0997	-0.0602	0.0937	0.1756	0.6243**
4	Number of primary branches per plant	-0.164	-0.0958	-0.1867	**-0.2145**	-0.2478	-0.0689	-0.1037	0.0996	-0.0516	-0.1481	0.7479**
5	Number of secondary branches per plant	-0.0621	-0.036	-0.0752	-0.0929	**-0.0804**	-0.0357	-0.0921	0.0017	-0.0063	-0.0701	0.9746**
6	Plant height (cm.)	-0.0667	-0.0739	-0.0497	-0.0397	-0.055	**-0.1238**	-0.0161	0.0695	-0.0733	-0.0658	0.563**
7	Number of pods per plant	0.0587	-0.0266	0.0541	0.08	0.1896	0.0215	**0.1655**	0.0118	-0.0638	0.0932	0.5882**

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8	**Number of seeds per pod**	0.0668	0.0715	0.0256	0.0604	0.0028	0.073	-0.0093	**-0.1301**	0.0834	0.0092	-0.072
9	**Hundred seed weight (g.)**	0.0355	0.0231	0.0184	0.0144	0.0047	0.0355	-0.0231	-0.0384	**0.0599**	-0.004	-0.104
10	**Biological yield per plant (g.)**	0.6561	0.3965	0.6418	0.7701	0.9722	0.5934	0.6283	-0.0788	-0.0737	**1.1157**	0.9328**

R Square = 1.0540

Residual effect = 0.2323

Note: Diagonal & Bold = Direct path and Red color = Correlation value

Table 4 Direct and indirect effect for different characters on seed yield per plant at phenotypic level in chickpea.

S.N.	Trait	Days to 50 percent flowering	Length of pod (cm.)	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	Hundred seed weight (g.)	Biological yield per plant (g.)	Seed yield per plant (g.)
1	**Days to 50 percent flowering**	**-0.0019**	-0.0006	-0.0015	-0.0009	-0.001	-0.001	-0.0005	0.0008	-0.0011	-0.0011	0.5548**
2	**Length of pod (cm.)**	-0.0043	**-0.0136**	-0.0045	-0.0042	-0.0035	-0.0073	0.0013	0.0056	-0.0045	-0.0044	0.316
3	**Days to maturity**	-0.0007	-0.0003	**-0.0009**	-0.0006	-0.0006	-0.0004	-0.0003	0.0002	-0.0003	-0.0005	0.544*

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4	**Number of primary branches per plant**	0.0002	0.0002	0.0003	**0.0005**	0.0003	0.0001	0.0002	-0.0002	0.0001	0.0002	0.4562*
5	**Number of secondary branches per plant**	0.0062	0.0032	0.008	0.0084	**0.0124**	0.0039	0.0088	-0.0011	0.0016	0.0072	0.5819**
6	**Plant height (cm.)**	-0.001	-0.0011	-0.0008	-0.0004	-0.0006	**-0.002**	-0.0002	0.0009	-0.0011	-0.001	0.5181*
7	**Number of pods per plant**	-0.0039	0.0015	-0.0044	-0.0054	-0.0112	-0.0015	**-0.0158**	-0.0001	0.0039	-0.0074	0.4629*
8	**Number of seeds per pod**	0.004	0.0041	0.0018	0.0034	0.0009	0.0047	0.0001	**-0.0098**	0.0052	0.0006	-0.066
9	**Hundred seed weight (g.)**	-0.0039	-0.0024	-0.0019	-0.0012	-0.0009	-0.004	0.0017	0.0037	**-0.0071**	0.0002	-0.038
10	**Biological yield per plant (g.)**	0.5603	0.3248	0.5481	0.4566	0.5861	0.5256	0.4677	-0.0656	-0.0344	**1.0058**	0.9998**

R Square = 0.9998

Residual effect = 0.0157

Note: Diagonal & Bold = Direct path and Red color = Correlation value

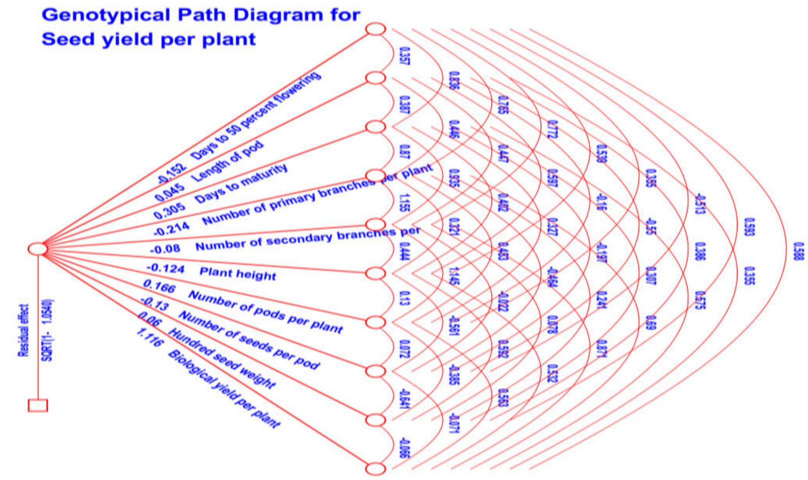

Fig. 1 Genotypic path diagram

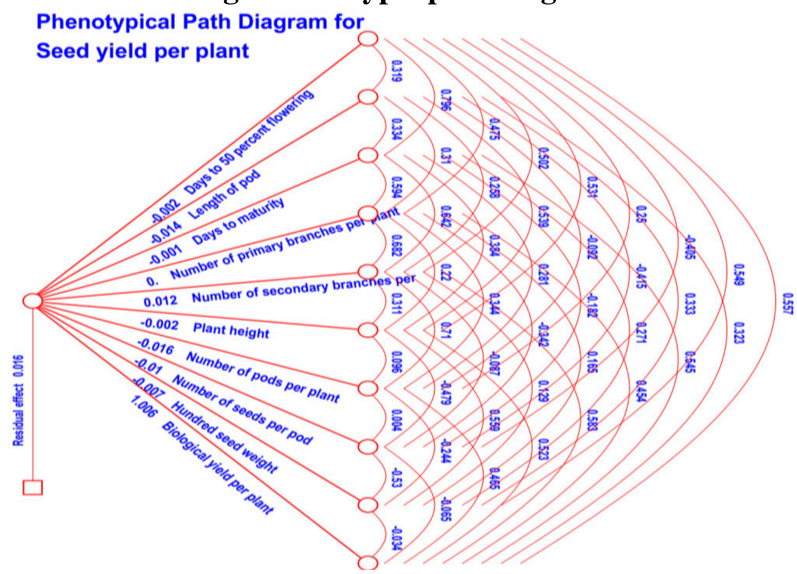

Fig. 2 Phenotypic path diagram

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