International Journal of Plant & Soil Science

33(19): 56-62, 2021; Article no.IJPSS.73333
ISSN: 2320-7035

Assessment of Genitic Variability, Cause Effect and Interrelationship among Yield Components in Chickpea (*Cicer arietinum* L.)

Kodam Swathi[1*] and Gabrial M. Lal[1]

[1]Department of Genetics and Plant Breeding, Naini Agricultural institute, SHUATS, Prayagraj, (U.P), India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2021/v33i1930600
Editor(s):
(1) Dr. Ahmed Medhat Mohamed Al-Naggar, Cairo University, Egypt.
Reviewers:
(1) Ayad Jameel Alkhafaji, University of Kufa, Iraq.
(2) Kehinde F. Jaiyeoba, Adeleke University, Nigeria.
(3) Rehana Salim, Sher-e-Kashmir University of Agricultural Sciences and Technology, India.
Complete Peer review History: https://www.sdiarticle4.com/review-history/73333

Original Research Article

Received 26 June 2021
Accepted 06 September 2021
Published 10 September 2021

ABSTRACT

The present investigation consists of 26 genotypes of Chickpea including one check, which were grown in the Field Experimentation Centre of the Department of Genetics and Plant Breeding, SHUATS, Prayagraj during Rabi 2020 following RBD with three replications. The data were recorded on 11 characters. Assessment of genetic variability, cause effect and interrelationship among yield components in chickpea. High significant variation was obtained for all characters studied. High GCV and PCV in chickpea germplasm were observed for Total no of pods per plant, number of effective pods per plant, biological yield, seed yield. High estimate of heritability coupled with high genetic advance as percent of mean was recorded for No. of primary branches, No. of secondary branches, Total no of pods per plant, No. of effective pods per plant, biological yield, Seed yield per plant, Harvest index, Seed index. High values for heritability indicates that it may be due to higher contribution of genotypic components. Traits exhibiting high heritability coupled with genetic advance as percent of mean suggest that the traits are governed by additive gene action, equal contribution of additive and non-additive gene action respectively. Correlation coefficient analysis revealed that seed yield per plant exhibited positive and significant association with Biological yield per plant, Harvest index and plant height at genotypic and phenotypic levels.

**Corresponding author: E-mail: swathikodam37@gmail.com;*

Correlation coefficient analysis revealed that seed yield per plant exhibited positive and significant association with Biological yield per plant, Harvest index and plant height at genotypic and phenotypic levels. Path analysis revealed that characters plant height, number of primary branches, biological yield and harvest index have positive direct effect on seed yield per plant at genotypic and phenotypic level.

Keywords: Chickpea; genetic variability; correlation and path analysis

1. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an integral part of an Indian agriculture since time immemorial, because of only its intrinsic value in terms of high protein content, carbohydrates, minerals, nitrogen fixing ability and indispensability as alternative crop for crop diversification. Chickpea (*Cicer arietinum* L.) belongs to genus *Cicer* and tribe Viciacae, sub-order Papilionaceae of order Leguminoseae (Bentham and Hooker, 1870). Out of total 39 known species are distributed mainly in central and western asia, two are found to be cultivated in india, viz., *Cicer arietinum* (2n = 14) which is most widely cultivated and *Cicer soongaricum* (2n = 16) cultivated in western temperate and alpine regions (9000-15000 ft.in altitude) of the Himalaya.

In India, chickpea is grown on 10.76 million hectares area and production contributed 11.16 million tonnes with the productivity of 1037 kg/ha in 2019-20. In U.P., chickpea production was 626 thousand tonnes with average yield of 1114 kg/ha from an area of 562 thousand ha during the year 2019-20 [1,2]. Chickpea from the regional variety trails was found to be a rich source mineral micro nutrients of iron Fe, Zn, Ca, Mg, K, Cu and P. The main proteins found in chickpeas, similar to other legumes, are Albumins and globulins. Smaller amounts of glutelins and prolamines are also present.

Selection is the basis of crop improvement and without genetic variability it could not be possible, hence it is necessary to make improvement in production of this crop by evaluation of different germplasm lines of chickpea. The efficiency of selection depends on identification of desirable genotypes and to know the extent of genetic variability present in population for trait of interest at phenotypic level [3-5]. The observed variability could be partitioned into heritable (genetic) and non-heritable (non-genetic) components. Hence the variability partitioned into heritable and non-heritable components with suitable genetic parameters such as genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2) and genetic advance (GA). The genetic variability in assed higher for number of pods/plant in chickpea as reported by Malik et al. [6] and Gul et al.

In chickpea association of one or more characters influenced by a large number of genes is elaborated statistically by correlation coefficients. Genotypic correlation coefficient provides measure of genotypes conjugation between characters. The methods of partitioning the correlation into direct and indirect effects by path coefficients analysis was suggested by Wright (1921).

2. MATERIALS AND METHODS

The present investigation comprised of 26 diverse genotypes of chickpea including check variety (Pusa 362) was carried out at Genetics and Plant Breeding Research Farm of Sam Higginbottom University of Agriculture Technology and Sciences, Naini, Prayagraj (U.P.) during *Rabi* 2020-21. The experiment was conducted in Randomized Block Design (RBD) with three replications. The genotypes were sown on raised bed on 24 December, 2020. The row to row and plant to plant distance was kept at 30×10 cm^2 spacing.

In each replication and in each plot, five plants were randomly selected and tagged excluding border plants to minimize border effects. Except, days to flowering and days to maturity, all the 11 characters studied were recorded on five randomly selected plants per plot. For days to flowering and days to maturity, the observations were recorded from the whole plot. Weights for studied were recorded in grams, with the help of a physical balance.

3. RESULTS AND DISCUSSION

The presence of genetic variability is beneficial to the evolutionary survival of a species. In any crop yield improvement can be brought about through plant breeding but necessary variability upon which selection is to be practiced must be

available in the genetic material of such crop. Therefore, before going to any crop improvement programme, a plant breeder must survey and asses the variability for a given agronomic or yield component characters which can be estimates through variance, coefficient of variability (GCV,PCV), heritability and genetic advance, genetic advance as percent of mean. Genotypic coefficient of variation (GCV) ranged from 1.02 for Days to 50% flowering to 32.156 for Seed yield per plant. High GCV (>20%) was recorded for Seed yield per plant (32.156). Moderate GCV (>10%) was recorded for No of secondary branches (15.992), No. of primary branches (15.631). Phenotypic coefficient of variation (PCV) ranged from 1.09 for Days to 50% flowering to 32.954 Seed yield per plant. High PCV (>20%) was recorded for Seed yield per plant (32.954), Moderate PCV (>10%) was recorded for No. of primary branches per plant (17.776). Heritability (%) in the broad sense ranged from 29% to 95.4%. High heritability (broad sense) (>60%) was recorded for characters Biological yield per plant (95.4). Genetic advance (Table 3) showed that it was highest for character Total no of pods per plant (10.758). study genetic advance as % of mean varied from 1.123% to 64.636%. High genetic advance as % of mean (>20%) was recorded for Seed yield per plant (64.636).

The yield related traits displaying positive and significant association with seed yield per plant suggested that seed yield can be improved through simultaneous selection for these traits. Selection is generally based on phenotypic expression of traits. Hence selection for traits exhibiting positive genotypic and positive phenotypic correlation would be major use in indirect selection of seed yield respectively. (Table 2) Seed yield per plant showed positive and highly significant correlation with Plant height (0.531**), Biological yield per plant (0.962**), Seed yield per plant (0.810**), (Table 3) Seed yield per plant showed positive and significant association with Plant height (0.281*), Biological yield per plant (0.916**) and Harvest index (0.688**).

The path coefficient analysis suggested by specified the effective measure of direct and indirect cause of association and also depicts the relative importance of each factor involved in contributing to the final product i.e., yield. In order to find out the cause and effect relationship between seed yield and its related characters, path analysis allow separating direct effect and indirect effects through other attributes by partitioning correlation (Table 4). At genotypic level, maximum positive direct effect was depicted by Days to 50% flowering (0.0476) followed by Days to maturity (0.0372), Plant height (0.0218), No. of primary branches (0.1005), Total no of pods per plant (0.6695), Biological yield(0.8329), Harvest index (0.3483). (Table 5) At phenotypic level, maximum positive direct effect was depicted by Plant height (0.0078) followed by No. of primary branches (0.0443), No. of effective pods per plant (0.0579), Biological yield per plant (0.7713), Harvest index (0.2846).

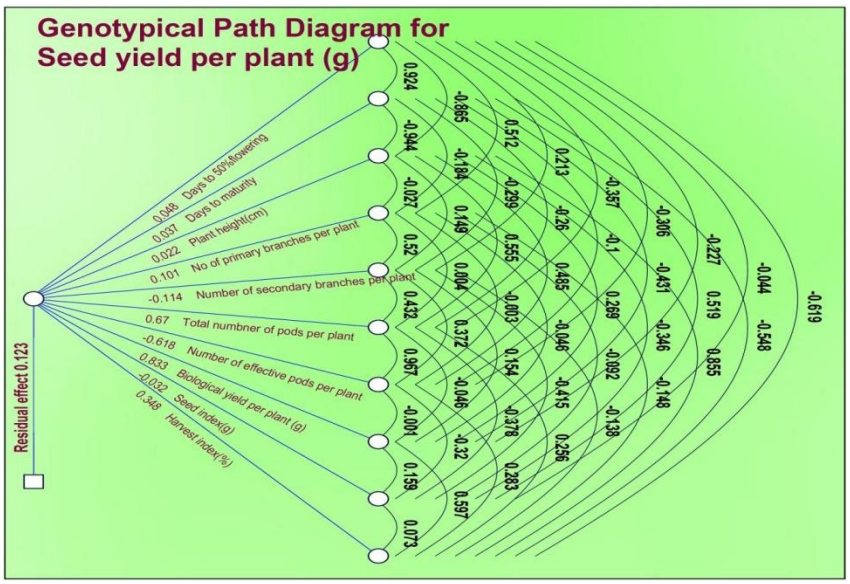

Fig. 1. Genotypic path for yield contributing traits for chickpea

Table 1. Estimation of components of variance and genetic parameters for 11 characters in chickpea genotype

Sl. No.	Characters	GCV	PCV	h^2 (%)	GA (5%)	GA as % of mean (5%)
1	Days to 50% flowering	1.02	1.909	36.24	0.916	1.123
2	Days to maturity	1.696	3.173	28.6	2.266	1.867
3	Plant height	4.282	7.956	29	1.784	4.747
4	Number of primary branches	15.631	17.776	77.3	0.657	28.314
5	Number of secondary branches	15.992	17.418	84.3	1.45	30.248
6	Total number of pods per plant	28.23	29.461	91.8	10.758	55.724
7	Number of effective pods per plant	28.544	29.565	93.2	9.101	56.77
8	Biological yield per plant	26.584	27.217	95.4	9.978	53.491
9	Seed index	12.093	13.583	79.3	4.226	22.179
10	Harvest index	10.914	12.699	73.9	9.389	19.321
11	Seed yield per plant	32.156	32.954	95.2	6.051	64.636

Vg = Genotypic variance; Vp = Phenotypic variance; GCV = Genotypic coefficient of variation; PCV = Phenotypic coefficient of variation; h^2(bs) = Heritability at broad sense; GA = Genetic advance; GAM = Genetic advance as percent mean.

Table 2. Genotypic correlation among the different traits in chickpea

	DF 50%	DM	PH	NPBP	NSBP	NPP	NEPP	BYPP	SI	HI	GYPP
DF 50%	1	0.924**	-0.865**	0.512**	0.2128	-0.357**	-0.306**	-0.2271	-0.0438	-0.619**	-0.363**
DM		1	-0.944**	-0.1842	- 0.299**	-0.260*	-0.1	-0.431**	0.519**	-0.548**	-0.602**
PH			1	-0.0274	0.1489	0.555**	0.485**	0.269*	-0.346**	0.855**	0.531**
NPBP				1	0.520**	0.0044	-0.003	-0.0464	-0.0918	-0.148	-0.0245
NSBP					1	0.432**	0.372**	0.1539	-0.415**	-0.1383	0.0927
NPP						1	0.967**	-0.0461	-0.378**	0.256*	0.0707
NEPP							1	-0.0008	-0.320**	0.283*	0.0868
BYPP								1	0.1589	0.597**	0.962**
SI									1	0.0725	0.1181
HI										1	0.810**
GYPP											1

DF 50% : Days to 50% flowering, DM : Days to maturity, PH : Plant height, NPBP : Number of primary branches per plant, NPSP : Number of secoundary branches per plant, NPP : Number of pods per plant, NEPP : Number of effective pods per plant, BYPP : Biological yield per plant, SI : Seed index, HI : Harvest index, GYPP : Grain yield per plant.

Table 3. Phenotypic correlation among the different traits in chickpea

Character	DF 50%	DM	PH	NPBP	NSBP	NPP	NEPP	BYPP	SI	HI	GYPP
DF 50%	1	0.2660 *	-0.1744	0.1834	0.1136	-0.1664	-0.1177	-0.0824	-0.0428	-0.3390 **	-0.2261
DM		1	-0.3681 **	-0.0155	-0.0969	-0.1815	-0.0788	-0.2282 *	0.2458 *	-0.2044	-0.315**
PH			1	-0.0342	0.107	0.2869 *	0.2357 *	0.1782	-0.2364 *	0.3511 **	0.281*
NPBP				1	0.4434***	0.019	-0.0139	-0.0239	-0.0684	-0.0961	-0.03
NSBP					1	0.3686 **	0.3121 **	0.1303	-0.3012 **	-0.0652	0.0697
NPP						1	0.8820 ***	-0.0351	-0.3006 **	0.2109	0.0574
NEPP							1	-0.004	-0.2470 *	0.2121	0.0836
BYPP								1	0.158	0.4814 ***	0.916**
SI								0.158	1	0.072	0.0967
HI										1	0.688**
GYPP											1

DF 50% : Days to 50% flowering, DM : Days to maturity, PH : Plant height, NPBP : Number of primary branches per plant, NPSP : Number of secoundary branches per plant, NPP : Number of pods per plant, NEPP : Number of effective pods per plant, BYPP : Biological yield per plant, SI : Seed index, HI : Harvest index, GYPP : Grain yield per plant.

Table 4. Direct and indirect effects of 11 traits on seed yield in chickpea at Genotypic level

Character	DF 50%	DM	PH	NPBP	NSBP	NPP	NEPP	BYPP	SI	HI	GYPP
DF 50%	0.0476	0.044	-0.0412	0.0244	0.0101	-0.017	-0.0146	-0.0108	-0.0021	-0.0295	-0.3626
DM	0.0343	0.0372	-0.0351	-0.0068	-0.0111	-0.0096	-0.0037	-0.016	0.0193	-0.0204	-0.6023
PH	-0.0188	-0.0206	0.0218	-0.0006	0.0032	0.0121	0.0106	0.0059	-0.0075	0.0186	0.5306
NSBP	0.0515	-0.0185	-0.0028	0.1005	0.0523	0.0004	-0.0003	-0.0047	-0.0092	-0.0149	-0.0245
NSBP	-0.0244	0.0342	-0.017	-0.0595	-0.1144	-0.0495	-0.0426	-0.0176	0.0475	0.0158	0.0927
NPP	-0.2388	-0.1738	0.3718	0.003	0.2895	0.6695	0.6476	-0.0309	-0.2532	0.1712	0.0707
NEPP	0.1893	0.0619	-0.3001	0.0018	-0.2302	-0.598	-0.6183	0.0005	0.1978	-0.1748	0.0868
BYPP	-0.1892	-0.3591	0.2244	-0.0387	0.1282	-0.0384	-0.0006	0.8329	0.1324	0.4975	0.9622
SI	0.0014	-0.0166	0.0111	0.0029	0.0133	0.0121	0.0103	-0.0051	-0.032	-0.0023	0.1181
HI	-0.2157	-0.1909	0.2978	-0.0515	-0.0482	0.0891	0.0985	0.208	0.0253	0.3483	0.8096
GYPP	-0.3626	-0.6023	0.5306	-0.0245	0.0927	0.0707	0.0868	0.9622	0.1181	0.8096	1
Partial R^2	-0.0173	-0.0224	0.0116	-0.0025	-0.0106	0.0473	-0.0537	0.8015	-0.0038	0.282	

DF 50% : Days to 50% flowering, DM : Days to maturity, PH : Plant height, NPBP : Number of primary branches per plant, NPSP : Number of secoundary branches per plant, NPP : Number of pods per plant, NEPP : Number of effective pods per plant, BYPP : Biological yield per plant, SI : Seed index, HI : Harvest index, GYPP : Grain yield per plant.

Table 5. Direct and indirect effects of 11 traits on seed yield in chickpea at Phenotypic level

Character	DF 50%	DM	PH	NPBP	NSBP	NPP	NEPP	BYPP	SI	HI	GYPP
DF 50%	-0.0537	-0.0143	0.0094	-0.0099	-0.0061	0.0089	0.0063	0.0044	0.0023	0.0182	-0.2261
DM	-0.0163	-0.0613	0.0226	0.001	0.0059	0.0111	0.0048	0.014	-0.0151	0.0125	-0.3153
PH	-0.0014	-0.0029	0.0078	-0.0003	0.0008	0.0022	0.0018	0.0014	-0.0018	0.0027	0.2812
NPBP	0.0081	-0.0007	-0.0015	0.0443	0.0197	0.0008	-0.0006	-0.0011	-0.003	-0.0043	-0.03
NSBP	-0.0053	0.0045	-0.005	-0.0206	-0.0464	-0.0171	-0.0145	-0.006	0.014	0.003	0.0697
NPP	0.0075	0.0082	-0.0129	-0.0009	-0.0166	-0.0451	-0.0398	0.0016	0.0136	-0.0095	0.0574
NEPP	-0.0068	-0.0046	0.0137	-0.0008	0.0181	0.0511	0.0579	-0.0002	-0.0143	0.0123	0.0836
BYPP	-0.0635	-0.176	0.1375	-0.0184	0.1005	-0.0271	-0.0031	0.7713	0.1219	0.3713	0.9158
SI	0.0018	-0.0102	0.0098	0.0028	0.0124	0.0124	0.0102	-0.0065	-0.0413	-0.003	0.0967
HI	-0.0965	-0.0582	0.0999	-0.0273	-0.0186	0.06	0.0604	0.137	0.0205	0.2846	0.688
GYPP	-0.2261	-0.3153	0.2812	-0.03	0.0697	0.0574	0.0836	0.9158	0.0967	0.688	1
Partial R^2	0.0122	0.0193	0.0022	-0.0013	-0.0032	-0.0026	0.0048	0.7064	-0.004	0.1958	

DF 50% : Days to 50% flowering, DM : Days to maturity, PH : Plant height, NPBP : Number of primar branches per plant, NSBP : Number of secoundary branches per plant, NPP : Number of pods per plant, NEPP : Number of effective pods per plant, BYPP : Biological yield per plant, SI : Seed index, HI : Harvest index, GYPP : Grain yield per plant.

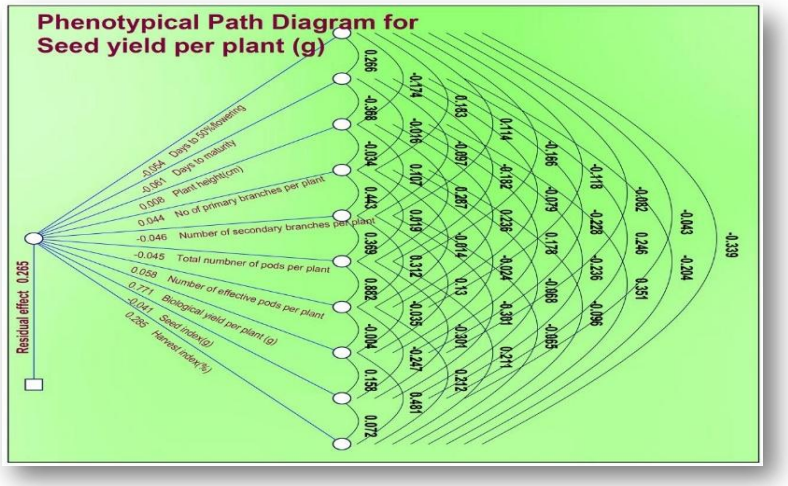

Fig. 2. Phenotypic path for yield contributing traits for chickpea

4. CONCLUSION

In the studied traits, phenotypic variances of Days to 50% flowering and Seed yield per plant were greater than genotypic variances, and this indicated that these traits are more influenced by environmental effects. According to the results of the correlation analysis, Seed yield per plant was significantly and positively correlated to biological yield per plant, Plant height, Harvest index. Improving these traits may increase Seed yield per plant. Path analysis of Seed yield per plant indicated that Plant height, Number of primary branches, Biological yield per plant, Harvest index exerted the greatest direct effect. These traits had major contributions to Seed yield per plant, and hence can increase the success of breeding studies of chickpea.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Saleem M, Tahir MHN, Kabir R, Javid M, Shahzad K. Interrelationships and path analysis of yield attributes in chickpea (*Cicer arietinum* L.). Int. J. Agric. Biol. 2002;4:404-406.
2. Shafique MS, Ahsan M, Mehmood Z, Abdullah M, Shakoor A, Ahmad MI. Genetic variability and interrelationship of various agronomic traits using correlation and path analysis in chickpea (*Cicer arietinum* L.). Academia Journal of Agricultural Research. 2016;4(2):082-085.
3. Tripathi AK. Variability analysis in chickpea. Adv. Plant Sci. 1998;11(2):291-292.
4. Yucel OD, Emin AA, Yucel C. Genetic variability, correlation and path analysis of yield, and yield components in chickpea (*Cicer arietinum* L.). Turk J Agric. 2006;183-188.
5. Zali H, Farshadfar E, Sabaghpour SH. Genetic variability and inter relationships among agronomic traits in chickpea (*Cicer arietinum* L.) genotypes. Crop Breeding Journal.2011;1(2): 127-132.
6. Hid MA, Ahmed R. Genetic variability, correlation studies and their implication in selection of high yielding genotypes in chickpea (*Cicer arietinum* L.). Sarhad Journal of Agriculture. 1999; 1016-4383.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/73333