International Journal of Plant & Soil Science

33(16): 108-114, 2021; Article no.IJPSS.70252
ISSN: 2320-7035

To assess the Character Association and Path Analysis in Chickpea (*Cicer arietinum* L.) Germplasm Lines Grown under Late Sown Condition

Subhadra Pattanayak[1*], Gabrial M. Lal[1], Velugoti Priyanka[1] and Avneeshmani Tripathi[1]

[1]Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, (U.P.), India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2021/v33i1630530
Editor(s):
(1) Dr. Francisco Cruz-Sosa, Metropolitan Autonomous University Iztapalapa Campus, México.
Reviewers:
(1) Rajeshkumar B. Madariya, Junagadh Agricultural University, India.
(2) G. Prabhakara Rao, Rubber Research Institute of India, India.
(3) Ravindra Prasad, BHU, India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/70252

Original Research Article

Received 01 May 2021
Accepted 06 July 2021
Published 09 July 2021

ABSTRACT

A set of twenty one chickpea genotypes were grown and asses to know the amount of genetic variability, genetic association seed yield and thirteen quantitative traits, direct and indirect effect of yield contributing characters on seed yield. Correlation coefficient analysis revealed that seed yield per plant exhibited positive and significant association with 50% pod setting and plant height at genotypic and phenotypic levels. Correlation coefficient analysis revealed that seed yield per plant exhibited positive and significant association with 50% pod setting and plant height at genotypic and phenotypic levels. Path analysis revealed that characters such as plant height, number of primary branches, number of seeds per pod, hundred seed weight, biological yield and harvest index have positive direct effect on seed yield per plant at genotypic level.

**Corresponding author: E-mail: subhadrapattanayak45@gmail.com;*

Keywords: Chickpea; correlation; genetic variability; path analysis.

1. INTRODUCTION

Pulse crops have an importance like cereals and other agricultural crops as they are important source of proteins particularly in the people's diet of tropical conditions. Chickpea (*Cicer arietinum* L.) belongs to family leguminosae, subfamily papilionaceae. It is an annual grain legume crop, self-pollinated, diploid species with 2n=2x=16 chromosomes [1,2]. This is an important cool season food legume grown as a winter crop in the tropics and as a summer or spring crop in the temperature environments. It likes cool, dry & bright weather and sensitive to extreme temperatures such as high (>30^0 c) as well as low (<5^0 c) at the reproductive stage [3-5].

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 thousands ha during the year 2019-20 [6,7].

The study of association between pairs of these yield contributing characters and yield provides basis for selection of important traits, which influence the yield. The association of one or more characters influenced by a large number of genes is elaborated statistically by correlation coefficient. Genotype correlation coefficient provides a measure of genotype conjugation between characters.

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 [8-10]. 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 reprted by Malik et al. [11] and Gul et al. [12]. The estimation of this genetic variability parameter helps breeder in achieving the required crop improvement by selection. The basic objective in most of the crop improvement programs is to realize a significant gains in the breeding programs through marked improvement in crop yield [13,14].

Path analysis developed by Wright [15] is a standardized partial regression analysis, which further permits the portioning of correlation coefficient into components of direct and indirect effect. By using direct and indirect effect of one variable on another can be estimated. It provides useful information on the relative merit of the desirable traits in the selection criterion.

2. MATERIALS AND METHODS

The present investigation comprised of 21 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* 2019-20. The experiment was conducted in Randomized Block Design (RBD) with three replications. The genotypes were sown on raised bed on 9th December, 2019. 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 13 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 association analysis among thirteen characters at genotypic and phenotypic levels is given in Table 1 and Table 2, respectively. In the present investigation correlation coefficient analysis measure the mutual relationship between various plant character and to determine the component characters on which selection can be used for genetic improvement in yield while selecting the suitable plant type, correlation studies would provide reliable information and the direction of the selection

Table 1. Genotypic correlation among the different traits in chickpea

	DF 50%	DP 50%	DM	PH	NPB	NSB	NPP	NSPod	NSPlant	HSW	BM	HI	SYLD
DF 50%	1	0.758**	0.486**	-0.0583	-0.1016	0.0976	-0.294*	-0.2332	-0.357**	0.1393	0.119	0.359**	0.199
DP 50%		1	0.414**	-0.0326	0.0719	0.298*	-0.268*	-0.401**	-0.378**	0.0405	0.325**	0.297*	0.395**
DM			1	-0.1273	0.294*	0.559**	-0.474**	-0.0598	-0.283*	0.294*	0.0249	-0.059	0.017
PH				1	0.1595	-0.1208	0.1191	-0.1332	-0.2195	-0.1025	0.398**	0.542**	0.504**
NPB					1	0.676**	-0.2028	-0.0825	-0.1848	-0.1226	-0.065	1.2325	0.0799
NSB						1	-0.0732	0.0146	-0.1885	-0.0557	-0.162	0.398**	-0.1172
NPP							1	0.601**	0.452**	-0.325**	-0.0426	0.417**	0.0181
NSPod								1	0.767**	-0.0251	0.0137	-0.376**	-0.0421
NSPlant									1	-0.1767	-0.0799	-0.2053	-0.1233
HSW										1	-0.1827	-0.267*	-0.2111
BM											1	-0.335**	1.0014
HI												1	-0.260*
SYLD													1

DF50%: Days to 50% flowering, DP50%: Days to 50% pod setting, DM: Days to maturity, PH: Plant height, NPB: Number of primary branch per plant, NSB: Number of secondary branch per plant, NPP: Number of pods per plant, NS Pod: Number of seeds per pod, NS Plant: Number of seeds per plant, HSW: Hundred seed weight, BM: Biomass, HI: Harvest index, SYLD: Seed yield per plant

Table 2. Phenotypic correlation among the different traits in chickpea

	DF 50%	DP 50%	DM	PH	NPB	NSB	NPP	NSPod	NSPlant	HSW	BM	HI	SYLD
DF 50%	1	0.5789***	0.3591**	-0.0483	-0.1002	0.0203	-0.1993	-0.1697	-0.2611 *	0.1517	0.0849	0.1215	0.147
DP 50%		1	0.3800**	-0.0179	-0.048	0.2289	-0.2244	-0.3591**	-0.3463**	0.0413	0.2985 *	0.0966	0.355**
DM			1	-0.1134	0.1679	0.4731***	-0.4186***	-0.0569	-0.2424	0.234	0.0212	0.0123	0.0362
PH				1	0.1073	-0.1092	0.1119	-0.1279	-0.196	-0.0821	0.3678**	0.1772	0.475**
NPB					1	0.4718***	-0.1409	-0.0515	-0.1225	-0.0764	-0.012	0.2411	0.0742
NSB						1	-0.0515	0.013	-0.1596	-0.0578	-0.1361	0.0955	-0.0938
NPP							1	0.5107***	0.4483***	-0.2553*	-0.0463	0.1154	0.0047
NSPod								1	0.6908***	-0.0011	0.0068	0.0143	0.0084
NSPlant									1	-0.1681	-0.0669	-0.0569	-0.1081
HSW										1	-0.1643	0.026	-0.137
BM											1	-0.2834*	0.880**
HI												1	0.1811
SYLD													1

DF50%: Days to 50% flowering, DP50%: Days to 50% pod setting, DM: Days to maturity, PH: Plant height, NPB: Number of primary branch per plant, NSB: Number of secondary branch per plant, NPP: Number of pods per plant, NS Pod: Number of seeds per pod, NS Plant: Number of seeds per plant, HSW: Hundred seed weight, BM: Biomass, HI: Harvest index, SYLD: Seed yield per plant

Table 3. Genotypic direct and indirect effects of 13 traits on seed yield in chickpea

Character	DF 50%	DP 50%	DM	PH	NPB	NSB	NPP	NS Pod	NS Plant	HSW	BM	HI	SYLD
DF 50%	**0.0266**	0.0201	0.0129	-0.0015	-0.0027	0.0026	-0.0078	-0.0062	-0.0095	0.0037	0.0032	0.0095	0.199
DP 50%	-0.0051	**-0.0068**	-0.0028	0.0002	-0.0005	-0.002	0.0018	0.0027	0.0026	-0.0003	-0.0022	-0.002	0.395**
DM	-0.0203	-0.0173	**-0.0417**	0.0053	-0.0122	-0.0233	0.0198	0.0025	0.0118	-0.0122	-0.001	0.0025	0.017
PH	-0.0017	-0.0009	-0.0036	**0.0285**	0.0046	-0.0034	0.0034	-0.0038	-0.0063	-0.0029	0.0114	0.0155	0.504**
NPB	0.0069	-0.0049	-0.02	-0.0108	**-0.068**	-0.046	0.0138	0.0056	0.0126	0.0083	0.0044	-0.0838	0.0799
NSB	0.0061	0.0185	0.0347	-0.0075	0.042	**0.0621**	-0.0045	0.0009	-0.0117	-0.0035	-0.0101	0.0247	-0.1172
NPP	0.0085	0.0077	0.0137	-0.0034	0.0059	0.0021	**-0.029**	-0.0174	-0.0131	0.0094	0.0012	-0.0121	0.0181
NS Pod	-0.0055	-0.0094	-0.0014	-0.0031	-0.0019	0.0003	0.0141	**0.0235**	0.018	-0.0006	0.0003	-0.0088	-0.0421
NS Plant	0.0041	0.0043	0.0032	0.0025	0.0021	0.0022	-0.0052	-0.0088	**-0.0114**	0.002	0.0009	0.0023	-0.1233
HSW	0.0021	0.0006	0.0044	-0.0015	-0.0019	-0.0008	-0.0049	-0.0004	-0.0027	**0.0151**	-0.0028	-0.004	-0.2111
BM	0.1244	0.34	0.026	0.416	-0.068	-0.1693	-0.0445	0.0143	-0.0836	-0.191	**1.0452**	-0.3504	1.0014
HI	0.0525	0.0434	-0.0086	0.0793	0.1805	0.0583	0.0611	-0.0551	-0.0301	-0.0392	-0.0491	**0.1465**	-0.260*
SYLD	0.199	0.395**	0.017	0.504**	0.0799	-0.1172	0.0181	-0.0421	-0.1233	-0.2111	1.0014	-0.260*	**1**

DF50%: Days to 50% flowering, DP50%: Days to 50% pod setting, DM: Days to maturity, PH: Plant height, NPB: Number of primary branch per plant, NSB: Number of secondary branch per plant, NPP: Number of pods per plant, NS Pod: Number of seeds per pod, NS Plant: Number of seeds per plant, HSW: Hundred seed weight, BM: Biomass, HI: Harvest index, SYLD: Seed yield per plant

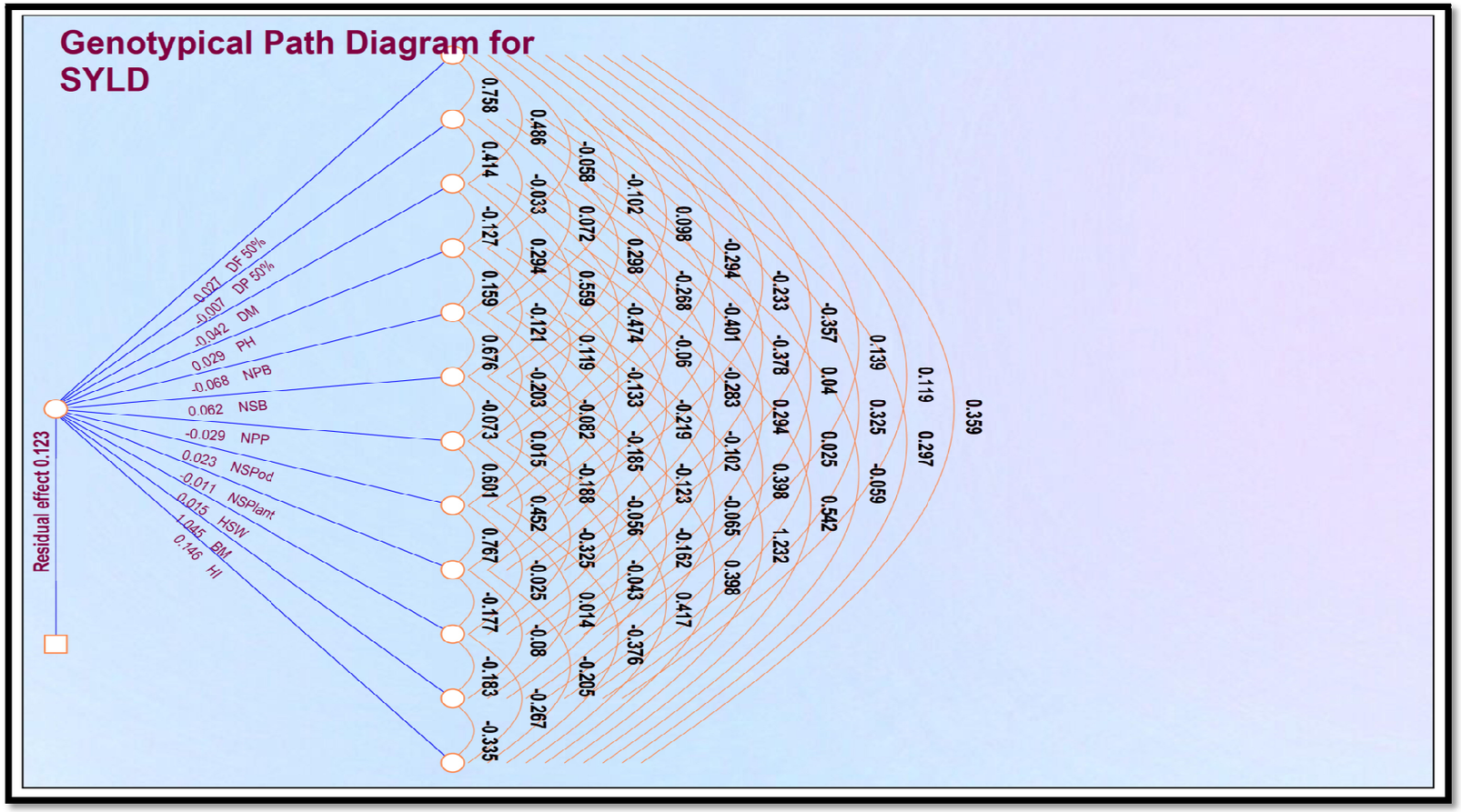

Fig. 1. Genotypic path for yield contributing traits of chickpea

especially when the breeder needs to combine high yield potential with desirable traits and seed quality traits. The seed yield per plant showed highly significant and positive association with days to 50% pod setting and plant height at both genotypic and phenotypic level. Such positive interrelationship between seed yield and these attributes have also been reported in chickpea by Kumar et al. [16] and Mushtaq et al. [17]. Subhadra Pattanayak, Velugoti Priyanka, Avneeshmani Tripathi.

Seed yield per plant showed negative and significant correlation with Harvest index (HI) and number of seeds per plant at genotypic and phenotypic level respectively. Days to 50% flowering which had positive and significant association with days to 50% pod setting, days to maturity and HI, is an important component in identifying and deciding the duration of crop. Days to 50% pod setting exhibited positive and significant correlation with days to maturity, seed yield per plant and biological yield. Days to maturity showed positive and significant association with number of secondary branches, number of primary branches and hundred seed weight. Plant height exhibited positive and significant correlation with seed yield per plant and biological yield. Number of primary branches per plant exhibited positive and significant correlation with number of secondary branches at both genotypic and phenotypic levels. Number of secondary branches per plant exhibited positive and significant association with harvest index at genotypic level. Number of pods per plant showed positive and significant correlation with number of seeds per pod and number of seeds per plant. Number of seeds per pod exhibited positive and significant correlation with number of seeds per plant. Biological yield showed positive and significant association with seed yield per plant at phenotypic level. The results thus, revealed that 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 the traits exhibiting positive significant genotypic and positive significant phenotypic correlation would be of major use in indirect and direct selection for seed yield respectively. The genotypic correlation coefficients of these characters with seed yield were partitioned into their direct and indirect effects through path-coefficient analysis (Table 3).

The maximum direct and positive effect on seed yield was exhibited by biological yield followed by harvest index, number of secondary branches, plant height, days to 50% flowering, Number of seeds per pod, hundred seed weight, days to 50% pod setting, number of seeds per plant, number pods per plant, days to maturity and number of primary branches (Fig. 1).

4. CONCLUSION

By considering the nature and extent of correlation coefficients and their direct and indirect effects, it can be concluded that improvement of chickpea crop for yield and its contributing traits could be brought through simultaneous selection for the plant height, number of primary branches, number of seeds per pod, hundred seed weight, biological yield and harvest index. Thus our findings indicates true relationship with seed yield per plant and direct selection for these traits would result in higher breeding efficiency for crop improvement mainly for yield. Thus, these traits might be ranked as the most important component trait for seed yield per plant in breeding programme.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Borate VV, Dalvi VV. Correlation and path analysis in chickpea. Journal of Maharashtra Agricultural Universities. 2010;35(1):43-46.
2. Burton GW. Quantitative inheritance in grasses.Proc. 6thInt. *Grassland Cong*. 1952;1:277-283.
3. Johnson HW, Robinson HE, Comstock RE. Estimation of genetic and environmental variability in soybean. Agron. J. 1955;47:314-318.
4. Kobraee S, Shamsi K, Rasekhi B, Kobraee S. Investigation of correlation analysis and relationship between grain yield and other quantitative traits in chickpea. African J. Biotech. 2010;9:2342-2348.
5. Thakur SK, Sirohi A. Correlation and path coffient analysis in chickpea (*Cicer arietinum L.*) under different seasons. Legume Research. 2009;32:1-6.
6. Al-Jibouri HA, Miller PA, Robinson HF. Genotypic and environmental variances and covariances in upland cotton crosses

of interspecific origin. Agron. J., 1958;50: 633-636.
7. Ali Q, Jehanzebfarooq MA, Saleem M. Elect. J. of Pl. Breed., 2010;1:328-333.
8. Burton GW, Vane de EH. Journal of Agronomy. 1953;45:478-481.
9. Dewey DR, Lu KH. A correlation and Path analysis of components of crested wheat grass seed production. Agron. J. 1959;51:515-518.
10. Fisher RA. The genetic theory of natural selection. Genetics by Strickberger, M.W. published by McMillan Co., New York. 1930;772.
11. Malik SR, Bakhsh A, Asif MA, Iqbal U, Iqbal SM. Assessment of genetic variability and interrelationship among some agronomic traits in Chickpea. Inter. J. Agric. Biol. 2010;12:81-85.
12. Guler M, Adak MS, Ulukan H. Determining relationships among yield and some yield components using path coefficient analysis in chickpea (*Cicer arietinum* L.). Eur.J Argon. 2001;14:161-166.
13. Jeena AS, Arora PP, Ojha OP. Variability and correlation studies for yield and its components in chickpea.Legume Research. 2005;28(2):146-148.
14. Zena AS, Arora PP, Upreti MC. Path coefficient for enhancing the yield of chickpea, Bhartiya Krishi Anusandhan Patrika. 2008;23:3-4.
15. Wright S. Correlation and causation. J. of Agric. Res. 1923;20:557-585.
16. Kumar, et al. Arora PP, Jeena AS. Genetic variability studies for quantitative traits in chickpea. Agric. Sci. Digest. 2001;21(4):263-264.
17. Mushtaq MA, Bajwa MM, Saleem M. Estimation of genetic variability and path analysis of grain yield and its components in chickpea (*Cicer arietinum* L.). Inter. J. Sci. Engineer. Res. 2013;4:1-4.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/70252