Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6528

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (2):** 1234-1237 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Genetic Studies of Association and Path Coefficient Analysis of Yield and Its Component traits in Chickpea (*Cicer arietinum* L.)

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Received: 11.03.2018 | Revised: 18.04.2018 | Accepted: 24.04.2018

ABSTRACT

The present investigation was conducted at Research Farm of Department of Genetics & Plant Breeding, Narendra Deva University of Agriculture and Technology, Faizabad (U.P.) during rabi, 2013-14 on 105 genotypes with 5 checks varieties in Augmented Block Design to study Correlation and Path coefficient analysis for yield attributes in Chickpea on 11 quantitative traits. Results revealed that the seed yield plant^{-1} showed highly significant and positive correlation with plant height, pods plant^{-1} , seeds pod^{-1} , biological yield plant^{-1}, harvest index, and 100 seed weight and positive but non-significant correlations with remaining characters. The highest positive direct effect on seed yield plant was exerted by harvest index followed by biological yield per plant and 100 seed weight. The inter-relationship among the characters identified above may be utilized in the breeding programme to exploit the yield potential and to develop high yielding varieties with target oriented research.

Key words: *Chickpea, Correlation, Path analysis, Yield plant^{-1}and Harvest index.*

INTRODUCTION

Pulses are wonderful gifts of the nature and rich source of dietary protein. They have unique ability of biological nitrogen fixation, deep root system, mobilization of insoluble soil nutrients, bring qualitative changes in soil physical properties and restore soil fertility along with this they arrest the declining trained in productivity of cereal based cropping systems. Inclusion of pulses in intensive cereal based cropping system acts as a component of integrated nutrient supply. Therefore, pulses have emerged as available option to improve soil health, conserve the natural resources and sustain the agricultural productivity. In India, total pulses were grown on an area of 25.26 m ha with production of 19.25 million tones and productivity 764 kg/ha in year 2013-14[3]. Chickpea is the premier pulse crop of India covering 9.93 million ha. Area and production contributing 9.53 million tonnes with the productivity of 960 kg/ha. In 2013-14.

Cite this article: Singh, V., Singh, P., Singh, D. K., Ashutosh and Nath, S., Genetic Studies of Association and Path Coefficient Analysis of Yield and Its Component traits in Chickpea (*Cicer arietinum* L.), *Int. J. Pure App. Biosci.* **6(2):** 1234-1237 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6528

The area, production and productivity of Uttar pradesh has been possessed 577.00 thousand ha, 475.40 thousand tonnes, 824 kg/ha respectively in year 2013-14. Despite of its nutritional values and economic importance, chickpea production is relatively low in our country; this is primarily due to poor genetic makeup of the cultivars available. Beside other reasons, the drought stress, poor management and biotic factors such as blight, wilt disease and pod borer are the major constraints to achieve potential yield. Yield is the major complicated traits that is an outcome of interaction of many plant characters and is highly influence by environmental changes. The direct selection of plant on seed yield basis may be misleading. Therefore, characters association (correlation) and path analysis must be studied to understand the contribution of genotype and environment towards the final yield before selection of plant.

MATERIAL AND METHODS

The experiment was conducted to evaluate the 105 genotypes of chickpea including elite lines and land races with five popular checks *viz.*, HK 94-134, KWR 108, GCP-105, Udai and Pant G-186, well adopted varieties of the region. These genotypes exhibiting wide spectrum of variation for various agronomical and morphological characters, were obtained from the germplasm maintained at Pulse Section of the University. Each line was grown in single row of 4m length representing a plot in non-replicated way, while checks were replicated ten times. Row to row and plant to plant spacing was kept 30cm and 10cm, respectively. On the basis of five randomly selected plants, data were recorded on number of primary branches plant^{-1}, number of secondary branches plant^{-1}, plant height (cm), pods plant^{-1}, seeds pod^{-1}, biological yield plant^{-1} (g), seed yield plant^{-1} (g), harvest index (%) and 100-seed weight (g) except days to 50% flowering and days to maturity which were recorded on plot basis.

Data recorded on eleven quantitative traits of chickpea genotypes were subjected to statistical analysis following correlation coefficients worked out as per Johansson *et al*.[5], and path analysis suggested by Dewey and Lu[4] were used to partition the correlation coefficient in to direct and indirect effects.

RESULTS AND DISCUSSION

The progress in plant breeding depends upon effective selection scheme based on the correlated and non-correlated response. The seed yield or economic yield in almost all the crops is referred as super character which results from the multiplicative interactions of several other characters which are termed as yield components. Thus, identification of important yield components and information about their association with seed yield and also with each other is very useful for selecting efficient genotypes for evolving high yielding varieties. In this respect, the correlation coefficient which provides symmetrical measurement of degree of association between two variables or characters, help us in understanding the nature and magnitude of association among yield and yield components. The phenotypic correlation coefficients are presented in Table-1. The result showed that Seed yield per plant exhibited positive and highly significant correlations with biological yield plant^{-1} (0.879), pods plant^{-1} (0.674), 100-seed weight (0.546), harvest index (0.528), plant height (0.471) and seeds per pod^{-1} (0.307). The positive non-significant correlation of seed yield per plant was found with secondary branches per plant (0.108), primary branches plant^{-1} (0.086), days to 50 per cent flowering (0.068) and days to maturity (0.066). Therefore, these characters emerged as most important factors in influencing seed yield in chickpea. The strong positive correlation of seed yield with the characters mentioned above has also been reported earlier in chickpea by Qurban *et al.*[1], Biological yield plant^{-1}, pods plant^{-1}, 100-seed weight, harvest index and plant height had strong positive associations with one another besides, having strong positive association with seed yield plant^{-1}, as earlier reported by Ojha *et al.*[7] and Kumar *et al*.[6]. Furthermore, days to 50 per cent

flowering, days to maturity, plant height, secondary branches plant^{-1}, pods plant^{-1} were strongly associated with each other and these traits add towards higher biomass. These findings are broadly in agreement with some of the earlier reports of Ojha *et al.*[7] and Qurban *et al.*[1].

Path analysis emerged as a powerful and widely used technique for understanding the direct and indirect contribution of yield contributing traits. In this study, the path coefficient analysis was carried out using estimates of simple correlation coefficients among 11 characters presented in Table-2 revealed that biological yield plant^{-1} (0.672) followed by 100 seed weight (0.359) and pods plant^{-1} (0.150) demonstrated highly positive direct contribution to seed yield plant^{-1}. The available literatures have also identified these characters as major direct contributors to seed yield plant in Chickpea [7.] However, other characters contributing substantially positive direct effect on seed yield harvest index (0.098), seeds pod^{-1} (0.097), secondary branches plant^{-1} (0.049), days to 50 per cent flowering (0.025), primary branches plant^{-1} (0.007) and plant height (0.006). The negative and substantial direct effects on seed yield plant^{-1} were exerted by days to maturity (-0.045). The remaining characters have little and non-significant effect and thus indicating their negligible direct contributions towards seed yield. The above finding is broadly in agreement with report of Yucel *et al.*[9], Qurban *et al.*[2] and Ojha *et al.*[7]

The maximum indirect and positive effect on seed yield was showed by biological yield plant^{-1} (0.402), (0.360), (0.328), (0.136) and (0.079) *via* pods plant^{-1}, plant height, harvest index, seeds pod^{-1} and 100-seed weight, respectively. Whereas, 100-seed weight (0.147), (0.082) (0.061), (0.051) and (0.51) *via* pods plant^{-1}, seeds pod^{-1}, harvest index, plant height and primary branches plant^{-1} exhibited positive indirect effects on seed yield plant^{-1}, respectively[8].

The remaining estimates of the indirect effects in the analysis were too low to be considered important. The estimate of residual effect (0.149) was negligible which reflects that majority of the yield contributing traits have been included in the study. In the present study, path analysis identified harvest index, biological yield plant^{-1} and pods plant^{-1} as important direct yield contributing characters, which were also found to be useful indirect contributors *via* each other. Biological yield plant^{-1}, harvest index, days to 50% flowering and plant height emerged as most important indirect yield components. The characters mentioned above, merit due consideration at the time of devising selection strategy aimed at developing high yielding varieties in chickpea.

Table 1: Estimates of simple correlation coefficients between eleven characters in Chickpea genotypes

Character	DF	DM	PH	PB	SB	PP	SPP	100 SW	BYP	HI	SYP
DF	**1.0000**	0.9383**	0.3782**	-0.1586	0.0576	0.2455*	-0.0605	0.0622	0.0507	-0.0684	0.0678
DM		**1.0000**	0.3979**	-0.1463	0.0678	0.2212*	-0.0719	0.0411	0.0629	-0.0095	0.0658
PH			**1.0000**	-0.1038	0.1865	0.4056**	-0.0828	0.1432	0.4877**	0.3354**	0.4713**
PB				**1.0000**	0.3564**	-0.0985	0.1828	0.1422	-0.0042	0.0934	0.0862
SB					**1.0000**	0.0251	0.0408	0.1200	0.0007	0.0649	0.1081
PP						**1.0000**	-0.1813	0.4084**	0.5983**	-0.0752	0.6740**
SPP							**1.0000**	0.2276*	0.2019*	0.1561	0.3072**
100 SW								**1.0000**	0.1174	0.1704	0.5458**
BYP									**1.0000**	0.5355**	0.8785**
HI										**1.0000**	0.5278**
SYP											**1.0000**

Traits: DF=Days to 50% flowering, **DM**=Days to maturity, **PH**=Plant height (cm), **PB**=Primary branches plant^{-1}, **SB**=Secondary branches plant^{-1}, **PP**=Number of pods plant^{-1}, **SPP**=Number of seeds pod^{-1}, **100 SW**= 100 seed weight (g), **BYP**=Biological Yield plant^{-1} (g), **HI**=Harvest index (%) and **SYP**=Seed yield plant^{-1} (g)

,* **Significant at 5 % and 1% probability levels, respectively.**

Table 2: Direct and indirect effects of ten characters on seed yield per plant in Chickpea germplasm

Characters	DF	DM	PH	PB	SB	PP	SPP	100SW	BYP	HI	CCSYP
DF	**0.0254**	0.0239	0.0096	-0.0040	0.0015	0.0062	-0.0015	0.0016	0.0013	-0.0017	0.0678
DM	-0.0424	**-0.0452**	-0.0180	0.0066	-0.0031	-0.0100	0.0033	-0.0019	-0.0028	0.0004	0.0658
PH	0.0022	0.0023	**0.0058**	-0.0006	0.0011	0.0024	-0.0005	0.0008	0.0028	0.0019	0.4713
PB	-0.0010	-0.0010	-0.0007	**0.0066**	0.0024	-0.0006	0.0012	0.0009	0.0000	0.0006	0.0862
SB	0.0028	0.0033	0.0091	0.0173	**0.0486**	0.0012	0.0020	0.0058	0.0000	0.0032	0.1081
PP	0.0370	0.0033	0.0611	-0.0148	0.0038	**0.1507**	-0.0273	0.0616	0.0902	-0.0113	0.6740
SP	-0.0059	-0.0070	-0.0080	0.0178	0.0040	-0.0176	**0.0973**	0.0221	0.0196	0.0152	0.3072
100 SW	0.0223	0.0148	0.0514	0.0511	0.0431	0.1467	0.0817	**0.3591**	0.0422	0.0612	0.5458
BYP	0.0341	0.0423	0.3280	-0.0028	0.0005	0.4024	0.1358	0.0790	**0.6727**	0.3602	0.8785
HI	-0.0067	-0.0009	0.0329	0.0092	0.0064	-0.0074	0.0153	0.0167	0.0526	**0.0982**	0.5278

Traits: DF=Days to 50% flowering, **DM**=Days to maturity, **PH**=Plant height (cm), **PB**=Primary branches plant^{-1}, **SB**=Secondary branches plant^{-1}, **PP**=Number of pods plant^{-1}, **SPP**=Number of seeds pod^{-1}, **100 SW**= 100 seed weight (g), **BYP**=Biological Yield plant^{-1} (g), **HI**=Harvest index (%) and **CCSYP**= Correlation coefficient with Seed yield plant^{-1} (g).

Residual effect=0.1499, Direct effects on main diagonal (bold figures)

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