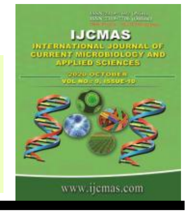
Int.J.Curr.Microbiol.App.Sci (2020) *9*(10): 3957-3967

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 10 (2020)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2020.910.455

Estimation of Phenotypic and Genotypical (Above Diagonal) Correlation Coefficients in Yield and its Component Characters Chickpea (*Cicer arietinum* L.)

Altaf B. Shaikh, D. K. Patil, Yogesh Pawar, Deepak A. Kharad and Prashant B. Kardile*

Genetics and Plant Breeding, Department of Agricultural Botany, COA, Badnapur, Dist- Jalna (VNMKV, Parbhani) (M.S.), India
**Corresponding author*

Keywords

Phenotypic, Genotypic, Correlation, Coefficients, Yield, Chickpea

Article Info

Accepted:
26 September 2020
Available Online:
10 October 2020

ABSTRACT

The present investigation entitled, Phenotypic and Genotypic path coefficient analysis Studies in Chickpea **(***Cicer arietinum* L.) was conducted at Agricultural Research Station, Badnapur, Dist- Jalna (VNMKV, Parbhani) (M.S.) during *Rabi* season of 2019-20. The exploration of genetically variable accession or genotypes is the key source of germplasm conservation and potential breeding material for the future use. The phenotypic coefficients of variation (PCV) were slightly higher than genotypic coefficients (GCV) of variation which suggest the role of environment in governing these traits. Similarly, the magnitude of GCV and PCV was observed high for the characters *viz.*, number of primary branches per plant followed by number of pods per plant, seed yield per plant and 100 seed weight. It indicates that selection of desired germplasm for these traits may be worthwhile for improving seed yield in future breeding programme.

Introduction

Chickpea (*Cicer arietinum* L.) belongs to the genus Cicer, family- leguminaceae. Chickpea is the self pollinated pulse crop having chromosome number 2n=14. Among the pulses, chickpea is important *Rabi* crop of India. It occupies the first position among the pulses grown in the country with maximum acreage and production in the world. In grain legumes, proteins are an important seed component and are responsible for their relevant nutritional socio-economic importance. The chickpea seed is a good source of proteins and carbohydrate, which together constitute 80 % of the total dry weight of seed. Pulses occupy unique position in Indian Agriculture because of their characteristics of maintaining and restoring soil fertility, besides high nutritive value. Pulses restore soil fertility through biological nitrogen fixation with the help of symbiotic bacteria *Rhizobium* in roots. Hence it fixes the high amount of nitrogen through environment. Among the pulses, chickpea is important *Rabi* crop of India. It occupies the first position among the pulses grown in the country with maximum average acreage and production.

India, a major pulse producing country, accounts roughly 33% of the total world production. Pulses are grown both during *Kharif* and *Rabi* seasons. Among the pulse, the chickpea is a important *Rabi* pulse crop of the India. Among all pulses chickpea contributes 36% area and 46% production in year 2017-2018. During 2017-2018 estimated area and production of chickpea in Maharashtra state is 18.92 lakh ha and 17.61 lakh tons respectively. In Maharashtra, the highest chickpea was grown on 19.29 lakh ha with the highest production of 19.41 lakh tones during 2016-17. The productivity was highest during 2016-2017 (1006kg/ha).

In India percentage of area is increased upto 10.82% during year 2017-18 as compared to previous year while percentage of area decreased by 4.28% in Maharashtra. Maharashtra is having 14.57% contribution in the area with 13.51% production share in the nation. Madhya Pradesh state is having the highest area of 35.91 lakh ha, production 45.89 lakh tons and productivity 1279 kg/ha during the year 2017-2018. During 2017-18, the area in Maharashtra was 20 lakh ha with production of 17.59 lakh tons and productivity is 882 kg/ha (Anonymous 2017).

In year 2018-19, Maharashtra was having 13.13 lakh ha area with production of 9.86 lakh tons productivity and 752 kg/ha is while Marathwada region is having 4.87 (36.21%) lakh ha area under chickpea, 2.88 (34.94%) tons production and 630 kg/ha productivity. In India chickpea is exported to countries like Algeria, Saudi Arab and Sri Lanka, Pakistan, Arab EMTS, gulf contries and however it is imported from Tanzania, USA Australia, Russia, and Canada. (Annonymous, 2018-19).

In year 2019-20, India was having 106 lakh ha area with production of 111 lakh tons with productivity1056 kg/ha while Maharashtra was having area 20.38 lakh ha with the production of 17.29 lakh tones and having productivity 848.55 kg/ha. Maharashtra occupying area about 19.22%, production 15.57%. While Marathwada having 10.59 lakh ha area with the production of 7.96 lakh tones with the productivity of 760.54 kg/ha (Annonymous, 2019-20).

Generally, plant breeders select the parents on the basis of phenotypic divergence, but for effective breeding, the knowledge of genetic diversity among the parents with respect to the particular characters which are to be improved is essential. Plant genetic resources or gene pool are the basis for global food security. They contain diversity of genetic material in traditional varieties, modern cultivars, currently cultivated varieties and crop wild relatives.

Mahalanobis's (1936) reported that D2 statistics is a powerful tool for estimating the divergence between two populations. Many studies based on D^2 technique also indicated that geographical isolation is not necessarily related to genetic diversity. It thus gives better idea about the magnitude of genetic divergence and is independent of size of sample and provides the basis for selection of parental lines for further breeding programme for improving particular character.

Genetic variation for traits is important in breeding programmes for selecting desirable genotypes from population. On the other hand, an analysis of the correlation between seed yield and yield components is essential for determining selection criteria of a particular character. Path coefficient analysis may useful to determine the direct effect of traits and their indirect effects on other traits.

In plant breeding, correlation coefficient analysis measures the mutual relationship between various variables and determines the component characters on which selection can be based for genetic improvement in yield. Correlation coefficient is a statistical measure which is used to find out the degree (strength) and direction of relationship between two or more variables. The genotypic and phenotypic paths are commonly estimated to determine yield contributing characters which are mostly useful for plant breeders and geneticists in selection of elite genotypes from diverse genetic population for further improvement.

Genetic diversity among parents, which is heritable, is a pre-requisite for any successful breeding programme. The proper choice of the parents in the breeding programme is very importance in further study. Generally plant breeder selects the parents on the basis of phenotypic divergence, but for effective breeding, the knowledge of genetic diversity amongst the parents with respect to the characters which are to be improved is essential. The association of one or more characters influenced by a large number of genes is elaborated statistically by correlation coefficients. Genotypic correlation coefficient provides a measure of genotypes conjugation between characters. The method of partitioning the correlation into direct and indirect effects by path coefficients analysis was suggested by Sewall Wright (1921). It provides useful information on the relative merits and demerits of the traits in the selection criteria.

Materials and Methods

The present investigation entitled, Genetic Divergence Studies in Chickpea (*Cicer arietinum* L.) was conducted at Agricultural Research Station, Badnapur, during *Rabi* season of 2019-20.

Experimental material comprising 40 germplasm lines with wider variability for different characters will be studied including 4 checks (2 from ICRISAT and 2 from ARS Badnapur) at ARS Badnapur. Out of 40 genotypes 36 with 2 checks from ICRISAT, Hyderabad, And 2 checks from ARS, Badnapur. The list of genotypes is given in Table 1.

Experimental design

Thirty six genotypes of chickpea along with four standard checks *viz.* Akash (BDNG-797), Digvijay, NBeG-47, JG(16) were evaluated in randomized block design with two replications during *Rabi* season of 2019-20. Each genotype was sown in four rows of 4 m length with spacing of 30 cm between rows and 10 cm within rows.

Correlations

Analysis of covariance was carried out by taking two characters at a time. The genotypic co-variance was calculated as per Johnson *et al.*, (1955) as below:

Environmental covariance (COV. $e_{1.2}$) = EMP

$$\text{Genotypic covariance (COV. } g_{1.2}) = \frac{\text{GMP} - \text{EMP}}{r}$$

Phenotypic covariance (COV. $p_{1.2}$) = (COV. $g_{1.2}$) + (COV. $e_{1.2}$)

Where,

GMP = Genotypic mean sum of product
EMP = Error mean sum of product
r = Replication

Appropriate variances and co-variances were used for calculating phenotypic and genotypic correlation coefficients (Johnson *et al.*, 1955).

The phenotypic correlation coefficient (r_p) was calculated as:

$$r_{p1.2} = \frac{COV._{p1.2}}{\sqrt{(\sigma^2_{p1}).(\sigma^2_{p2})}}$$

Where,

$r_{p1.2}$ = Phenotypic correlation coefficient between character 1 and 2

$COV._{p1.2}$ = Phenotypic covariance between character 1 and 2.

σ^2_{p1}, σ^2_{p2} = Phenotypic variance of character 1 and 2 respectively.

The significance of the phenotypic correlation coefficient was tested by referring to Fisher and Yates (1943). The genotypic correlation coefficient (rg) was calculated as:

$$r_{g1.2} = \frac{COV._{g1.2}}{\sqrt{(\sigma^2_{g1}).(\sigma^2_{g2})}}$$

Where,

$r_{g1.2}$ = Genotypic correlation coefficient between character 1 and 2

$COV._{g1.2}$ = Genotypic covariance between character 1 and 2

σ^2_{g1}, σ^2_{g} = Genotypic variance of character 1 and 2 respectively.

The significance of correlation coefficients was tested from the statistical table of correlation coefficient at 1 and 5 per cent level of significance (Snedcor and Cochran, 1967).

Nyende *et al.,* (2015) found that the first 4 principal components explained significant proportion of the total variations which accounted for 77.04 percent. The first principal component was positively correlated with plant spread, plant height, number of primary and secondary branches per plant, days to flowering, days to maturity, pods per plant, pod length; biomass and seed yield. The presence of substantial genetic variations, positive and highly significant correlated characters can be exploited in breeding programmes for improvement of chickpea in the geographical region.

Chopdar (2016) studied twenty genotypes of chickpea with three replications. In the present study seed yield per plant found to have highly significant positive correlation with primary branches per plant, number of pods per plant, harvest index, number of seeds per pod, biomass per plant and 100 seed weight respectively. The expression of yield depends upon a number of yield contributing character. The selection practiced for one character may bring change in the other related character.

Bhanu (2017) reported positive significant relationship between seed yield number of secondary branches and number of primary branches and number of pods per plant. This results showed that any positive increase in such traits will improve the seed yield of chickpea crop. Since secondary branches plant seems to be an important yield component in present study this character shows positive correlation with seed yield plant, number of pods plant and number of primary branches. This showed that number of secondary branches would increase seed yield plant, number of pods plant and number of primary branches but with negative effect on hundred seed weight.

Shanmugam, *et al.,* (2019) analysis of variance revealed significant variation existed for most of the traits. High genotypic coefficient of variation and phenotypic coefficient of variation was found for hundred seed weight and plant height recorded high heritability with high genetic advance. Traits such as number of secondary branches, 100 seed weight, protein content, number of seeds per plant, biological yield per plant and harvest index exhibited significant positive correlation with seed yield per plant, where biological yield per plant followed by harvest index have positive and greater direct effects on single plant yield.

Shara, *et al.,* (2019) estimated relationships among yield and some yield components using correlation and path coefficient analysis in chickpea growing under rainfed condition. The character seed yield shows positive and highly significant correlation with most characters including number of branches per plant, deep of roots, number of pods per plant, number of seeds per pod, plant height, 100 seed weight, dry mater weight, pod weight per plant, protein percentage and biological weight.

Characters dry matter weight per plant recorded the highest positive direct effect on seed yield reached, while the maximum positive indirect effect on seed yield recorded by weight of pods per plant via dry matter weight per plant with.

Shedge, *et al.,* (2019) in his studies showed that the traits *viz.* harvest index, number of pods per plant, number of primary branches per plant, number of secondary branches per plant, days to 50% flowering, plant height, days to maturity, number of seeds per pod estimate positive and highly significant genotypic correlation with seed yield.

This exhibit that the continuous improvement of these characters through selection. Path coefficient analysis indicate that the characters *viz.* plant height and number of primary branches per plant exhibited negative direct effect on seed yield per plant.

Results and Discussion

Correlation studies

The genotypic and phenotypic correlations for yield and its component characters studied are presented in Table 3 & 4 and Fig. 1 and 2. The only significant correlations either in positive or negative directions are described in this chapter. In general, genotypic correlation coefficients were higher than their corresponding phenotypic correlation coefficients.

Association of seed yield with its components

Seed yield per plant had positive significant correlation with number of pods per plant (p=0.6197; g=0.6068), number of seed per pod (p=0.6197;g=0.3489), 100 seed weight (p=0.2979;g=0.3619), secondary branches per plant (p=0.2839; g=0.9968), harvest index (p=0.0371;g=0.0337) and number of primary branches per plant (p=0.0479;g=-0.0119).

Interrelationship of yield components

Initial plant stand

Initial plant stand showed significant and positive association with number of primary branches per plant (p=0.2741; g=0.5456).

Days to 50 per cent flowering

Days to 50 per cent flowering showed significant and positive association at both phenotypic and genotypic level with days to maturity (p=0.2952; g=5.7945), plant height (p=0.1272; g=0.8789), number of seeds per pod (p=0.1224; g=1.8154) and number of secondary branches (p=0.0471; g=0.0609).

Days to maturity

The characters *viz.* days to 50% flowering (p=0.2952; g=5.7945), number of seed per pod (p=0.1647; g=0.1913), plant height (p=0.0480; g=0.0643) and 100 seed weight (p=0.0169; g=0.0609) had significant and positive association with days to maturity at both phenotypic and genotypic level respectively. While it had the significant and negative association with number of secondary branches per plant (p=-0.2471; g=-0.4221).

Table.1 List of forty genotypes of chickpea

Sr. No.	Genotypes	Sr. No.	Genotypes
1.	ICCV181601	21	ICCV181101
2.	ICCV181602	22	ICCV181102
3.	ICCV181603	23	ICCV181103
4.	ICCV181604	24	ICCV181104
5.	ICCV181605	25	ICCV181105
6.	ICCV181606	26	ICCV181106
7.	ICCV181607	27	ICCV181107
8.	ICCV181608	28	ICCV181108
9.	ICCV181609	29	ICCV181109
10.	ICCV181610	30	ICCV181110
11.	ICCV181611	31	ICCV181111
12.	ICCV181612	32	ICCV181112
13.	ICCV181613	33	ICCV181113
14.	ICCV181664	34	ICCV181114
15	ICCV181667	35	ICCV181115
16	ICCV181668	36	ICCV181116
17	ICCV181673	37	ICCV181117
18	ICCV181674	38	ICCV181118
19	NBe G 47 (Ch)	39	JG 16 (Ch)
20	BDNG 797 (Ch)	40	DIGVIJAY (Ch)

Table.2

Source	Degree of Freedom	Sum of squares	Mean sum of squares	Expectation of mean sum of squares
Replications	(r-1)	RP	RMP	$COVe_{1.2+\,g}COVr_{1.2}$
Genotypes	(g-1)	GP	GMP	$COVe_{1.2\,+\,r}COV_{g1.2}$
Error	(r-1) (g-1)	EP	EMP	$COVe_{1.2}$

Table.3 Estimation of phenotypic (above diagonal) correlation coefficients in chickpea

Characters	Initial plant stand	Days to 50 % flowering	Days to maturiy	Plant height	Number of primary branches / plant	Number of secondary branches / plant	Number of pods / plant	Number of seeds / pod	100 seed weight	Harvest Index	Seed yield /plant
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Initial plant stand	**1.0000**	-0.1518	-0.1192	-0.1080	0.2741 *	-0.0552	-0.0439	-0.0705	-0.2007	-0.1955	**-0.1535**
Days to 50 % flowering		**1.0000**	0.2952 **	0.1272	-0.1635	0.0471	-0.0265	0.1224	-0.2940 **	-0.0930	**-0.0888**
Days to maturity			**1.0000**	0.0480	-0.1408	-0.2471 *	-0.0422	0.1647	0.0169	-0.1576	**-0.0505**
Plant height				**1.0000**	0.3489 **	0.2651 *	-0.0380	-0.0023	-0.0404	-0.0395	**-0.0108**
No. of primary branches / plant					**1.0000**	0.4017 ***	0.1612	0.0860	-0.3128 **	-0.1992	**0.0479**
No. of secondary branches / plant						**1.0000**	0.3010 **	0.0063	-0.2531 *	-0.1741	**0.2839**
Number of pods per plant							**1.0000**	0.2115	-0.2565 *	-0.3016 **	**0.6197**
Number of seeds per pod								**1.0000**	-0.0887	-0.1682	**0.6197**
100 seed weight									**1.0000**	0.3322 **	**0.2979**
Harvest index										**1.0000**	**0.0371**
Seed yield /plant											**1.000**

***** Significant at 5 % level of probability or level of significance,****** Significant at 1 % level of probability or level ofsignificance

Table.4 Estimation of Genotypical (above diagonal) correlation coefficients in chickpea

Characters	Initial plant stand	Days to 50 % flowering	Days to maturity	Plant height	Number of primary branches / plant	Number of secondary branches / plant	Number of pods / plant	Number of seeds / pod	100 seed weight	Harvest Index	Seed yield /plant
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Initial plant stand	**1.0000**	-4.4232	-0.1271	-0.2382	0.5456	0.1222	-0.1064	0.0179	-0.4170	-0.3923	**-0.1743**
Days to 50 % flowering		**1.0000**	5.7945	0.8789	-0.1985	0.0609	1.0339	1.8154	2.1927	-3.6410	**2.5584**
Days to maturity			**1.0000**	0.0643	-0.2024	-0.4221	-0.1317	0.1913	0.0609	-0.1821	**-0.1804**
Plant height				**1.0000**	0.3489	0.3084	-0.0703	-0.0072	-0.0433	-0.0265	**-0.0379**
No. of primary branches / plant					**1.0000**	0.3880	0.1353	0.1073	-0.3211	-0.2193	**-0.0119**
No. of secondary branches / plant						**1.0000**	0.2704	-0.0130	-0.2626	-0.1761	**0.1784**
Number of pods per plant							**1.0000**	0.2407	-0.2465	-0.3242	**0.6068**
Number of seeds per pod								**1.0000**	-0.0951	-0.1882	**0.3489**
100 seed weight									**1.0000**	0.3452	**0.3619**
Harvest index										**1.0000**	**0.0337**
Seed yield per plant											**1.000**

***** Significant at 5 % level of probability or level ofsignificance,
******Significant at 1 % level of probability or level ofsignificance

Fig.1 Diagram showing the phenotypic correlation in yield and its component characters of Chickpea

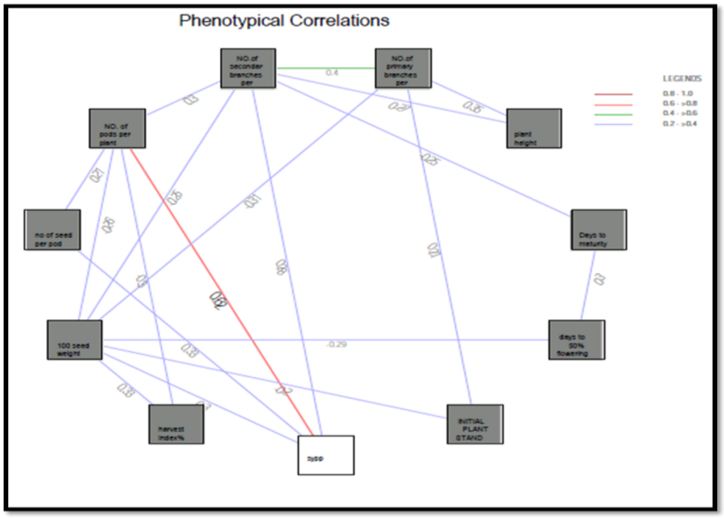
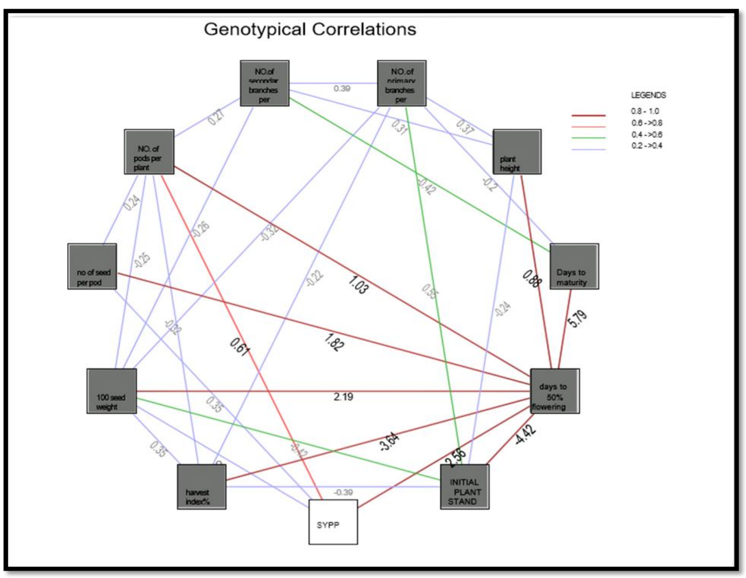


Fig.2 Diagram showing the genotypic correlation in yield and its component character of Chickpea



Plant height

The character plant height had positively significant correlation with number of primary branches per plant (p=0.3489; g=0.3489), number of secondary branches per plant (p=0.2651; g=0.3084) and days to maturity (p=0.0480; g=0.0643), at both phenotypic and genotypic level respectively.

Number of primary branches with other characters

The number of primary branches per plant showed significant positive correlation at both phenotypic and genotypic level with number of secondary branches per plant (p=0.4017; g=0.3880), plant height (p=0.3489;g=0.3489), number of pods per plant (p=0.1612;g=0.1353) and initial plant stand (p=0.2741;g=0.5456). While it had the significant and negative relation with 100 seed weight (p=-0.3128; g=-0.2024) and 100 seed weight (p=-0.3128; g=-0.3211).

Number of secondary branches per plant

The number of secondary branches per plant showed significant positive correlation with number of primary branches per plant (p=0.4017; g=0.3880), number of pods per plant (p=0.3010; g=0.2704), seed yield per plant (p=0.2839;g=0.1784) both at phenotypic and genotypic level.

Number of pods per plant

The number of pods per plant showed highly significant positive correlation with seed yield per plant (p=0.6197;g=0.6068), number of secondary branches per plant (p=0.3010; g=0.2704) number of seed per pod(p=0.2115;g=0.2407) and both at phenotypic and genotypic levels while significant and negative correlation with 100 seed weight (p=-0.2565; g=-0.2465) at phenotypic and genotypic level.

Number of seeds per pod

The number of seeds per pod showed highly significant positive correlation with seed yield per plant (p=0.6197;g=0.3489) and number of pods per plant (p=0.2115;g=0.2407) and number of primary branches per plant (p=0.0860;g=0.1073) both at genotypic and phenotypic level.

100 seed weight

100 seed weight showed significant positive correlation with harvest index (p=0.3322; g=0.3452), seed yield per plant (p=0.2979;g=0.3619) and negatively correlated with number of primary branches per plant (p=-0.3128; g=-0.3211) both at phenotypic and genotypic level.

Harvest index

Harvest index had significant positive correlation with harvest index (p=0.3322;g=0.3452) both at phenotypic and genotypic level. While significant and negative correlation with number of pods per plant (p=-0.3016;g=-0.3242).

In conclusion the correlation studies at both genotypic and phenotypic levels were made to resolve the direction and magnitude of association among characters. It indicates that strong inherent association between various character studied and genotypic expression of correlation was comparatively less influenced by the environmental condition. The traits *viz.* number of pods per plant, number of seeds per pods,100 seed weight, number of secondary branches per plant, harvest index, number of primary branches per plant also exhibited positive and highly significant genotypic correlations with seed yield. This indicates the simultaneous improvement of these characters through selection.

References

Bhanu A. N., Singh M.N., Tharu R. and Saroj S.K. 2017. Genetic variability, correlation and path coefficient analysis for quantitative traits in chickpea genotypes. *Indian J. Agric. Res.*, 51(5): 425-430.

Chopdar D.K., Baudhbharti, Sharma P.P., Dubey R.B., Bragendra and Meena B.L. 2016. Studies on genetic variability, character association and path analysis for yield and its contributing traits in chickpea (*Cicer arietinum* L.). *Agril. Res. Communiction Centre J. Legume res.* 40(5): 824-829.

Johnson, H.W., Robinson, H.F. and

Comstock, R.E. 1955. Genotypic and phenotypic correlation in soybean and their implications in selection. *Agron. J*., 47: 477-482.

Mahalanobis, P.C. 1936. On generalized distance in statistics. *Proc. Nat. Ins. Sci. India*. 2: 49-55.

Nyende A. B. and Rao, N.V., Ganga P. R. 2015. Assessment of interrelationship among agronomic and yield characters of chickpea. *Int. J. of Agril. And Crop Sci*. 8(2): 128-135.

Shanmugam Mohan and Kalaimagal Thiyagarajan. 2019. Genetic Variability, Correlation and Path Coefficient Analysis in Chickpea (*Cicer arietinum* L.) for Yield and its Component Traits. *Int.J.Curr.Microbiol.App.Sci*.8(05): 1801-1808.

Shara J. Hama 2019. Correlation and Path Coefficient Analysis for Seed Yield and Yield Components in Chickpea under Rainfed Condition. *Journal of Kerbala for Agricultural Sciences* Vol.(6), No.(1) (2019).

Shedge P. J., D. K. Patil and Gite V. K. 2019. Study on Genetic Divergence in Desi Chickpea (*Cicer arietinum* L.). *Int.J.Curr.Microbiol.App.Sci*.8(07): xx-xx.

How to cite this article:

Altaf B. Shaikh, D. K. Patil, Yogesh Pawar, Deepak A. Kharad and Prashant B. Kardile 2020. Estimation of Phenotypic and Genotypical (Above Diagonal) Correlation Coefficients in Yield and its Component Characters Chickpea (*Cicer arietinum* L.). *Int.J.Curr.Microbiol.App.Sci*. 9(10): 3957-3967. doi: https://doi.org/10.20546/ijcmas.2020.910.455