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Correlation and Path Coefficient Analysis of Yield and Yield Components in Chickpea (*Cicer arietinum* L.)

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A B S T R A C T

The present investigation was carried out for, "Correlation and Path Coefficient Analysis of Yield and Yield Components in Chickpea (*Cicer arietinum* L.)". Correlation studies showed that the traits *viz.* harvest index, number of pods per plant, number of secondary branches per plant, days to 50% flowering, plant height, days to maturity, number of primary branches per plant and number of seeds per pod exhibited positive and highly significant genotypic correlation with seed yield. This indicates that the simultaneous improvement of these characters through selection. Path coefficient analysis indicated that the characters *viz.* plant height and number of primary branches per plant exhibited negative direct effect on seed yield per plant. Hence, the selection of genotypes based on these characters as selection criterion would be helpful in improving the seed yield potential of chickpea.

Introduction

Among the pulse, the chickpea is a first important *Rabi* pulse crop of the region. Among all pulses chickpea contributes 36% area and 46% production in year 2017-18. During 2017-18 estimated area and production of chickpea in Maharashtra was 18.92 lakh ha and 17.61 lakh ton respectively. In Maharashtra, highest chickpea was grown on 19.29 lakh ha with the highest production of 19.41 lakh tones during 2016-17. The productivity is also highest during 2016-17 (1006kg/ha). In India percentage of area is increased upto 10.81% during year 2017-18 as compared to previous year while percentage of area decreased by 4.38% in Maharashtra. Maharashtra is having 14.69% contribution in the area with 13.74% production share in the nation (average of last ten years). Madhya Pradesh is having highest area of 35.90 lakh ha, production 45.95 lakh tons and productivity 1280 kg/ha during the year 2017-18. During 2017-18, the area in Maharashtra was 20 lakh ha with production of 17.61 lakh tons and productivity is 881 kg/ha.

(Anonymous, 2017). In year 2018-19, Maharashtra was having 13.14 lakh ha area with production of 9.87 lakh tons and productivity is 751 kg/ha while Marathwada is having 4.78 (36%) lakh ha area under chickpea, 2.99 (35%) tons production and 630 kg/ha productivity. In India chickpea is exported to countries like Pakistan, Arab EMTS, Algeria, Saudi Arab and Sri Lanka and however it is imported from Australia, Russia, Tanzania, USA and Canada (Annonymous, 2018-19).

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 phenotypic and genotypic paths are commonly estimated to determine yield contributing characters which are useful for plant breeders and geneticists in selection of elite genotypes from diverse genetic population. 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 Wright (1921). It provides useful information on the relative merits of the traits in the selection criteria. 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.

In applied plant breeding, the correlation and path analysis provide information on genetic association of yield and different yield contributing characters, which in turn are useful in developing breeding strategies.

Materials and Methods

The present investigation on chickpea for correlation and path analysis was conducted at Agricultural Research Station, Badnapur, during *Rabi* season of 2017-18. The experimental materials used for study consisted of fourty three genotypes of chickpea, out of which 25 genotypes were obtained from International Crop Research Institute for Semi-Arid Tropics, Hyderabad, 15 genotypes from the A.R.S. Badnapur and three standard checks. Forty genotypes of chickpea along with three standard checks *viz.* Akash (BDNG-797), Digvijay, JAKI 9218 were evaluated in a randomized block design with two replications during *Rabi* season of 2017-18. Each genotype was sown in two rows of 4 m length with spacing of 45 cm between rows and 10 cm within rows. The data were recorded on five randomly selected plants of each replication for all characters such as days to 50% of flowering, days to maturity, plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per pod, harvest index and seed yield. The genotypic co-variance was calculated as per Johnson *et al.*, (1955). To establish a cause and effect relationship the partitioning of genotypic and phenotypic correlation coefficient was done into direct and indirect effects by path analysis as suggested by Dewey and Lu (1959) and developed by Wright (1921).

Results and Discussion

Correlation coefficients

The characters *viz.* harvest index, number of pods per plant, number of secondary branches per plant, plant height, days to maturity and

days to 50 % flowering recorded highly positive significant correlation with seed yield. Seed yield per plant had positive significant correlation with harvest index (p=0.6975; g=0.9968) (Fig. 1). Vaghela *et al.*, (2009) found that seed yield per plant exhibited significant and positive correlation with harvest index, number of primary branches per plant and 100 seed weight at genotypic as well as phenotypic levels. Seed yield per plant had positive significant correlation with number of pods per plant (p=0.4947; g=0.6217). Earlier studies too have indicated such positive significant correlation for number of pods per plant by Guler *et al.*, (2001). Number of secondary branches per plant (p=0.4089; g=0.5344), plant height cm (p=0.3459; g=0.4314) also showed significant positive correlation with seed yield per plant. Arshad *et al.*, (2004) found that seed yield had positive and significant correlation with plant height, number of pods per plant and 100 seed weight (Table 1–3).

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

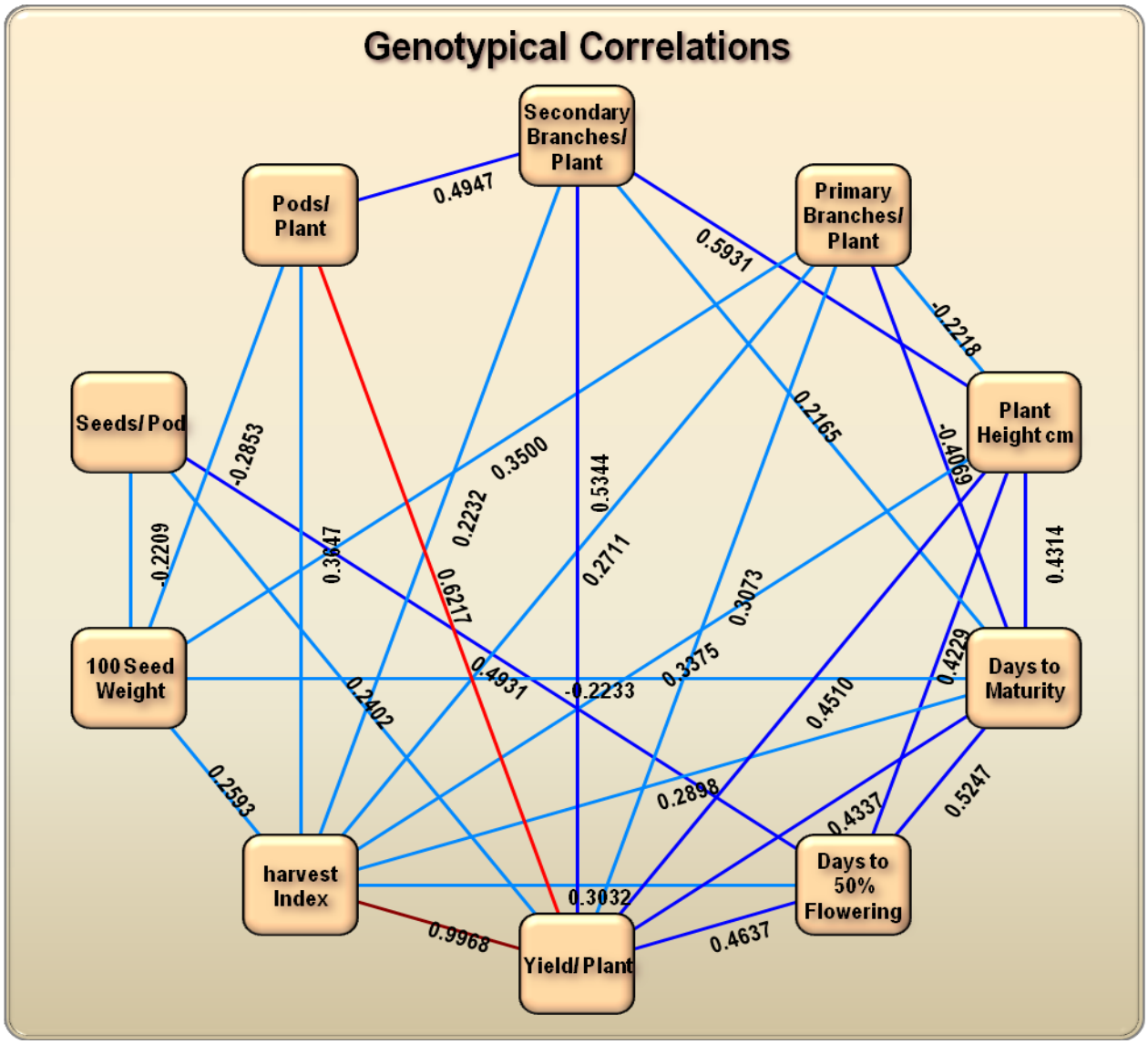

Table.1 Estimation of phenotypic (above diagonal) correlation coefficients in chickpea

Characters	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**
Days to 50 % flowering	**1.000**	0.4845**	0.3240**	-0.0757	0.0920	-0.0241	0.4259**	-0.0523	0.2902**	0.2584*
Days to maturity	0.5247**	**1.000**	0.3459**	-0.3480**	0.2027	0.1353	0.0580	-0.2112	0.2772**	0.3124**
Plant height	0.4229**	0.4229**	**1.000**	-0.3119**	0.4712**	0.1725	0.0852	0.1575	0.2743*	0.4045**
Number of primary branches per plant	-0.1380	-0.4069**	-0.2218*	**1.000**	0.0659	0.0605	0.0274	0.2437*	0.2051	0.0881
Number of secondary branches per plant	0.1292	0.2165*	0.5931**	0.1611	**1.000**	0.4548**	-0.0719	-0.0249	0.1878	0.4089**
Number of pods per plant	0.0023	0.1398	0.1208	0.1743	0.4947**	**1.000**	-0.0088	-0.2388*	0.3315**	0.4947**
Number of seeds per pod	0.4931**	0.0442	0.0729	-0.0084	-0.0367	-0.0435	**1.000**	-0.1806	0.1883	0.1273
100 seed weight	-0.0564	-0.2233*	0.1380	0.3500**	-0.0522	-0.2853	-0.2209*	**1.000**	0.2344*	0.1883
Harvest index	0.3032**	0.2898**	0.3375**	0.2711*	0.2232*	0.3647**	0.1986	0.2593*	**1.000**	0.6975**
Seed yield per plant	0.4637**	0.4337**	0.4510**	0.3073**	0.5344**	0.6217**	0.2402*	0.1994	0.9968**	**1.000**

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

Table.2 Direct and indirect effect of yield and its component characters on grain yield at phenotypic level

Characters	Days to 50 % flowering	Days to maturity	Plant height	Number of primary branches per plant	Number of secondary branches per plant	Number of pods per plant	Number of seeds per pod	100 seed weight	Harvest index	Total phenotypic correlation with seed yield / plant
Days to 50 % flowering	**0.0225**	0.0109	0.0073	-0.0017	0.0021	-0.0005	0.0096	-0.0012	0.0065	0.2585
Days to maturity	0.0513	**0.1059**	0.0366	-0.0368	0.0215	0.0143	0.0061	-0.0224	0.0293	0.3124
Plant height	0.0255	0.0272	**0.0787**	-0.0245	0.0371	0.0136	0.0067	-0.0124	0.0216	0.4045
No. of primary branches per plant	0.0013	0.0058	0.0052	**-0.0168**	-0.0011	-0.0010	-0.0005	-0.0041	-0.0034	0.0881
No. of secondary branches per plant	0.0126	0.0277	0.0643	0.0090	**0.1366**	0.0621	-0.0098	-0.0034	0.0256	0.4089
Number of pods per plant	-0.0071	0.0399	0.0509	0.0179	0.1342	**0.2951**	-0.0026	-0.070	0.0978	0.4947
Number of seeds per pod	0.0266	0.0036	0.003	0.0017	-0.0045	-0.0005	**0.0623**	-0.0113	0.0117	0.1273
100 seed weight	-0.0094	-0.0379	0.0282	0.0437	-0.0045	-0.0428	-0.0324	**0.1793**	0.0420	0.1883
Harvest index	0.1353	0.1293	0.1279	0.0956	0.0876	0.1546	0.0878	0.1093	0.4663	0.6975

Residual effect = 0.6017, Underlined figures indicate direct effect.
*, ** indicates significant at 5 and 1 % level of significant respective

Table.3 Direct and indirect effect of yield and its component characters on grain yield at genotypic level

Characters	Days to 50 % flowering	Days to maturity	Plant height	Number of primary branches per plant	Number of secondary branches per plant	Number of pods per plant	Number of seeds per pod	100 seed weight	Harvest index	Total genotypic correlation with seed yield / plant
Days to 50 % flowering	**0.1754**	0.0920	0.0742	-0.0242	0.0227	0.0004	0.0865	-0.0099	0.0532	0.4637
Days to maturity	0.0690	**0.1315**	0.0567	-0.0535	0.0285	0.0184	0.0058	-0.0294	0.0381	0.4337
Plant height	-0.0772	-0.0787	**-0.1825**	0.0405	-0.1082	-0.0220	-0.0133	-0.0252	-0.0616	0.4510
No. of primary branches per plant	0.0022	0.0064	0.0035	**-0.0159**	-0.0026	-0.0028	0.0001	-0.0055	-0.0043	0.3073
No. of secondary branches per plant	0.0405	0.0678	0.1858	0.0505	**0.3133**	0.10	-0.0115	-0.0163	0.0699	0.5344
Number of pods per plant	0.0006	0.0358	0.0309	0.0446	0.1267	**0.2561**	-0.0111	-0.0731	0.0934	0.6217
Number of seeds per pod	0.0374	0.0034	0.0055	-0.0006	-0.0028	-0.0033	**0.0758**	-0.0167	0.0151	0.2402
100 seed weight	-0.013	-0.0407	0.0251	0.0638	-0.009	-0.020	-0.0402	**0.1822**	0.0472	0.1994
Harvest index	0.2261	0.02161	0.2517	0.2022	0.1664	0.2720	0.1481	0.1934	0.7458	0.9968

The charaters *viz*. days to maturity (p=0.3124; g=0.4337) and days to 50 % flowering (p=0.2584; g=0.4637) also recorded highly positive significant correlation with seed yield. In other words, an increase in the magnitude of these characters would lead to an increase in the magnitude of grain yield.

Path analysis

In path coefficient analysis the characters, harvest index, number of pods per plant, number of secondary branches per plant, days to maturity and days to 50 % flowering had positive direct effect on seed yield in decreasing order of magnitude. Among all the components number of harvest index exhibited the highest direct effect (p=0.4663) on seed yield followed by number of pods per plant (p=2951), 100 seed weight (p=0.1793), number of secondary branches per plant (p=0.1366), days to maturity (p=0.1059), plant height (p=0.0787), seeds per pod (p=0.0623), days to 50% flowering (p=0.0225), while primary branches (p=-0.0168) recorded negative direct effect at phenotypic level. Similar results were reported by Talebi *et al.,* (2007) for number of pods per plant, number of seeds per pod and harvest index.

At genotypic level harvest index exhibited the highest positive direct effect (g=0.7458) on seed yield followed by secondary branches per plant (g=0.3133). Zali *et al.,* (2011) recorded number of secondary branches per plant, plant height had positive direct effect on seed yield. The characters *viz.* number of pods per plant (g=0.2561), 100 seed weight (g=0.1822), days to 50% flowering (g=0.1754), days to maturity (g=0.1315), number of seeds per pod (g=0.0758) exhibited the highest positive direct effect and negative direct effect by number of primary branches per plant (g=-0.0159) and plant height (g=-0.1825). Thakur and Sirohi (2009) reported highest positive direct effect of harvest index and number of pods per plant on grain yield. These findings revealed that these were major yield contributing traits in chickpea. Path coefficient analysis indicated that the characters *viz.,* plant height and number of primary branches per plant exhibited negative direct effect on seed yield per plant. But these characters had positive indirect effect *via.* another character on seed yield. Hence, the selection of genotypes based on these characters as selection criterion would be helpful in improving the seed yield potential of chickpea.

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