Study of correlations and path evaluations to find yield contributing characters in chickpea genotypes

Abstract

One of the most critical parts of any crop breeding effort is the identification of potent parents with specific yield-contributing features. In Rabi 2018-19, the Pulses improvement project, Mahatma Phule Krishi Vidhyapeeth (MPKV), Rahuri, Maharashtra, India, performed a study with thirty-three chickpea genotypes (along with three checks) in a Randomized Block Design (RBD) with two replications. Each plot was made up of a single 4-meter-long row with a 30 × 10 centimetre spacing. Seed yield per plant exhibited a high significant positive correlation with the number of pods per plant, plant spread, plant height, and the number of secondary branches per plant, according to correlation studies. 100 seed weight showed high significant positive correlation with plant height and significant negative correlation with no of seeds per pod. Path coefficient analysis exposed that days to 50% flowering, no of primary branches per plant, no of secondary branches per plant, plant height and no of pods per plant had positive direct effect on seed yield per plant. Days to maturity, plant spread, no of seeds per pod and 100 seed weight showed negative direct effect on seed yield per plant (Table 3). The number of pods per plant, the number of secondary branches per plant, and the height of the plant all demonstrated a positive and significant relationship with seed yield per plant, as well as having direct positive effects. As a result, these characters could be considered for improving chickpea yield.

Keywords: *Chickpea; correlation analysis; analysis of path coefficient; seed yield.*

1. Introduction

Chickpea (*Cicer arietinum* L.) is a popular wintertime leguminous plants with a wide geographic range. All through 2019, globally it turned into grown on 13,785,213 ha area, with the overall production of 14,184,449 tonnes (FAOSTAT, 2019)[7]. India, which ranks first in both area and output, contributes 71 percent of global area and 70 percent of global production of chick pea. The country produces roughly 9 million tonnes of chickpeas per year, accounting for about 27% of global imports but just 4% of gross supply in India. These are mostly desi chickpeas. In contrast, Indian chickpea exports, which account for roughly 3% of total production, are primarily kabuli chickpea (FAO, 2019) [13]. The chickpea (Fabaceae) is a self-pollinated true diploid (2n = 2x = 16) with a 738 Mbp genome (Varshney *et al*., 2013a) [17]. It is a man-cultivated annual cool-season food legume crop that has been discovered in Middle Eastern archaeological sites dating from 7500 to 6800 BC (Zohary and Hopf 2000) [19]. (Saxena, 1990) [16] reports that it is primarily grown in semi-arid areas. *Cicer reticulatum* was identified the wild progeny of cultivated chickpea by Ladizinsky and Adler (1976) [10], with South-Eastern Turkey being the crop's origin. Two awesome chickpea cultivated varieties are regarded (Cubero, 1975) [3]: the desi kind, with pink vegetation, angular. brown, small seeds with a high percentage of fibre, typically found in South Asia and Africa; and the kabuli type, with white plant life and owl-head-shaped, beige, large seeds and have a low fibre content, mainly found in Mediterranean nations. Chickpea contains 22 *percent* protein, 63 *percentage* carbohydrates, 4.5 *percent* fats, 8 *percentage* crude fibre and 27 *percent* ash (Miao *et al*., 2009) [11]. The nutritionally critical unsaturated fatty acids linoleic and oleic acids are abundant in chickpea. Chickpea oil contains significant sterols such as β-Sitosterol, campesterol, and stigmasterol (Jukanti *et al*., 2012) [9]. One of the most essential concerns for a breeder is yield improvement. Correlation and path evaluation research for yield criteria are significant elements of conventional breeding methods for most excellent plant kind choice. Using correlation coefficient studies, one can identify the association between characteristics of plants and seed yield. Path analysis determines the direct and indirect consequences of the cause components on the effect components, i.e., seed yield. In relation to a number of variables taken together, path analysis is an effective method to determine the degree of divergence at the genotype level. Using this approach, we can measure the degree of divergence among genotypes and determine both direct and indirect effects of various plant characters on yield. As a result, the current study looked at the degree and direction of relationship between distinct features, as well as the direct and indirect contribution of independent variables to the dependent variable in 33 chickpea genotypes.

2. Materials and Methods

MPKV-Rahuri, ARS-Badnapur, PDKV-Akola, and the Pulses Improvement Project, MPKV, Rahuri, Maharashtra, provided 33 chickpea genotypes (Table 1), along with 3 check varieties *viz*., Digvijay, Vijay, and Vishal. The experiment site is situated at 19.40N and 74.80E latitude and longitude, respectively. With an average annual rainfall of 541 millimetres and a mean altitude of 530 metres above mean sea level, the area is drought prone. The usual annual maximum and minimum temperatures are 30 to 40 degrees Celsius and 11 to 20 degrees Celsius, respectively. Ten plants were chosen for each genotype in each row to record characters such as days to 50% flowering, days to maturity, number of primary branches per plant, number of secondary branches per plant, plant height, plant spread, number of pods per plant, number of seeds per pod, 100 seed weight, and seed yield per plant, as well as their mean values for statistical analysis. Correlation was calculated using the methods of Johnson *et al.* (1955) [8] and path coefficient analysis by Dewey and Lu (1959) [6] and Wright (1921) [18]. Collected data were analyzed with INDOSTAT software .

Table No 1: List of thirty three chickpea genotypes.

Serial No	Genotype	Serial No	Genotype
Collection from: MPKV RAHURI, ARS BADNAPUR, PDKV AKOLA			
1	Phule G 15109	2	Phule G 0819-43
3	Phule G 16101	4	Phule G 1022-3
5	Phule G 1010-4	6	Phule G 16115
7	Phule G 1022-10-6	8	Phule G 171112
9	Phule G 1115-13-6	10	BDNG 2017-44
11	BDNG 2017-49	12	BDNG 2017-21
13	BDNG 2017-23	14	BDNG 2015-1
15	BDNG 2017-06	16	BDNG 2016-2
17	BDNG 21-1	18	AKG 1506
19	AKG 1401	20	AKG 1303
21	AKG 1301	22	AKG 1402
23	Phule G 16312	24	Phule G 0739

25	BDNG 2018-1	26	Phule G 171101
27	Phule G 171103	28	Phule G 171104
29	Phule G 171105	30	Phule G 171113
31	Digvijay	32	Vishal
33	Vijay		

3. Results and Discussion

3.1. Genotypic Correlation.

In character association studies; seed yield per plant showed high significant positive correlation with no of pods per plant (0.909), plant spread (0.364), plant height (0.305) and no of secondary branches per plant (0.388), whereas, non significant negative correlation with days to 50% flowering (-0.125). 100 seed weight showed high significant positive correlation with plant height (0.308) and significant negative correlation with no of seeds per pod (-0.279) (Table 2). Similar finding had been suggested by Chand and Singh, (1997) [2]; Jeena and Arora, (2001) [1]. Correlation coefficient estimation was done at both genotypic and phenotypic level. The genotypic correlation coefficients were higher than their corresponding phenotypic correlations displaying more involvement of additive genes. Significant positive correlation was noticed for no of seeds per pod with no of primary branches per plant (0.988), whereas, negative correlation with days to 50% flowering (-0.075), days to maturity (-0.035), no of secondary branches per plant (-0.099), plant height (-0.217) and plant spread (-0.056). Significant positive correlation was noticed for no of pods per plant with no of secondary branches per plant (0.331), plant height (0.309) and plant spread (0.467), whereas, negative correlation with days to 50% flowering (-0.117). Significant positive correlation was noticed for plant spread with days to 50% flowering (0.322), no of secondary branches per plant (0.476) and plant height (0.371), whereas, negative correlation with no of primary branches per plant (-0.142). Significant positive correlation was noticed for plant height with days to 50% flowering (0.556) and days to maturity (0.464), whereas, negative correlation with no of primary branches per plant (-0.0004). This results also supplements the findings of Singh *et al*. (1990) [14]. Significant positive correlation was noticed for no of secondary branches per plant with no of primary branches per plant (0.307) and days to maturity with days to 50% flowering (0.412). Similar results have also been reported by Dasgupta *et al*. (1992) [4].

In general, genotypic correlations among characteristics that affect seed yield per plant describe significant connection since they take environmental factors out of the equation. By selecting based on these correlations, it might be possible to increase chickpea seed yield per plant. As a result, breeding programs for chickpeas can improve their selection efficiency by better understanding the relationship between yield and its component characteristics as well as among the component characters themselves. It is a well-established fact that correlation studies between yield and yield components are necessary to develop efficient breeding strategies. Breeders of chickpeas are in the same condition. Quantitative factors like seed yield per plant are closely linked to a variety of other traits. Modifications in the expression of one feature are frequently related to changes in the expression of numerous different traits. As a result, the current study's correlations can be used to choose features that have a direct and significant correlation with increasing seed yield per plant.

Table No 2: Genotypic (represented above diagonal) and Phenotypic (represented below diagonal) correlation coefficients of chickpea.

Characters	Days to 50% flowering	Days to maturity	No of primary branches plant^{-1}	No of secondary branches plant^{-1}	Plant height (cm)	Plant spread (cm)	No of pods plant^{-1}	No of seeds Pod^{-1}	100 seed weight (g)	Seed yield plant^{-1} (g)
Days to 50% flowering	**1.000**	0.412**	0.015	0.067	0.556**	0.322**	-0.117	-0.075	0.089	-0.125
Days to maturity	0.379 **	**1.000**	0.036	0.235	0.464**	0.111	0.206	-0.035	0.091	0.133
No of primary branches plant^{-1}	0.029	0.029	**1.000**	0.307*	-0.0004	-0.142	0.102	0.988**	0.076	0.107
No of secondary branches plant^{-1}	0.003	0.213	-0.033	**1.000**	0.131	0.476**	0.331**	-0.099	0.119	0.388**
Plant height (cm)	0.494 **	0.442**	-0.104	0.181	**1.000**	0.371**	0.309**	-0.217	0.308**	0.305**
Plant spread (cm)	0.208	0.101	-0.213	0.487 **	0.363 **	**1.000**	0.467**	-0.056	0.025	0.364**
No of pods plant^{-1}	-0.120	0.196	0.002	0.334 **	0.320 **	0.443 **	**1.000**	0.105	0.078	0.909**
No of seeds Pod^{-1}	-0.074	-0.003	0.185	0.098	-0.064	0.051	0.083	**1.000**	-0.279*	0.101
100 seed weight (g)	0.071	0.084	-0.027	0.153	0.322 **	0.050	0.090	-0.134	**1.000**	0.119
Seed yield plant^{-1}	-0.140	0.119	0.003	0.377**	0.315**	0.346**	0.902**	0.090	0.134	**1.000**

*, ** suggest significant at the level of 5 % and 1% level, respectively

3.2. Path Coefficient Analysis.

Correlations were further divided into direct and indirect impacts using path coefficient analysis to determine the direct and indirect effects of these variables on seed yield Table 3 and Figure 1 show the results of path coefficient analysis of all other traits to plant seed yield. The number of primary branches per plant, number of secondary branches per plant, days to 50% flowering, plant height and number of pods per plant all had a positive direct effect on seed yield per plant, according to the results of path coefficient analysis. Sozen and Karadavut (2018) [15] have similar findings. The highest direct positive effect on seed yield per plant was exhibited by no of pods per plant (0.951). This implies that higher no of pods per plant leads to increased seed yield per plant; the genotypic correlation between no of pods per plant and seed yield per plant (r_g=0.909) is predominately attributed to the direct effect (0.951) of no of pods per plant on the seed yield per plant (Figure 1). Days to maturity, plant spread, no of seeds per pod and 100 seed weight showed negative direct effect on seed yield per plant. No of pods per plant, no of secondary branches per plant and plant height show positive and significant association with seed yield per plant and also had direct positive effects. Similar results have also been reported by Dawane *et al*. (2020) [5]. As a result, these characteristics could be considered the most relevant for selection in order to increase chickpea seed yield. According to Rasul *et al*. (2012) [12], the number of pods per plant is a major component in determining the yield performance of leguminous plants. In this present study we got the residual effect is 0.382, which means 38.2% of variance explained for dependent trait may be due to error, environment or other factors which are not included in the study.

Table No 3: Genetic direct and indirect effects of nine causal variables on seed yield in chickpea .

Sr. No.	Characters	Days to 50% flowering	Days to maturity	No of primary branches plant^{-1}	No of secondary branches plant^{-1}	Plant height (cm)	Plant spread (cm)	No of pods plant^{-1}	No of seeds Pod^{-1}	100 seed weight (g)	Total genotypic correlation with seed yield per plant
1	**Days to 50% flowering**	**0.028**	-0.051	0.002	0.008	0.039	-0.047	-0.111	0.010	-0.002	-0.125
2	**Days to maturity**	0.011	**-0.124**	0.004	0.027	0.032	-0.011	0.196	0.005	-0.002	0.133
3	**No of primary branches plant^{-1}**	0.0004	-0.004	**0.122**	0.035	0.000	0.021	0.097	-0.161	-0.002	0.107
4	**No of secondary branches plant^{-1}**	0.002	-0.029	0.038	**0.113**	0.009	-0.069	0.315	0.013	-0.003	0.388**
5	**Plant height (cm)**	0.015	-0.057	0.000	0.015	**0.070**	-0.054	0.294	0.029	-0.008	0.305**
6	**Plant spread (cm)**	0.009	-0.014	0.017	0.054	0.026	**-0.145**	0.445	0.008	-0.0006	0.364**
7	**No of pods plant^{-1}**	-0.003	-0.025	0.012	0.037	0.022	-0.068	**0.951**	-0.014	-0.002	0.909**
8	**No of seeds Pod^{-1}**	0.002	0.004	0.145	-0.011	0.015	0.008	0.101	**-0.136**	0.007	0.102
9	**100 seed weight (g)**	0.005	-0.011	0.009	0.013	0.021	-0.007	0.075	0.038	**-0.025**	0.119

Direct effects are indicated by underlined numbers.

*, ** suggest significant at the level of 5 % and 1% level, respectively

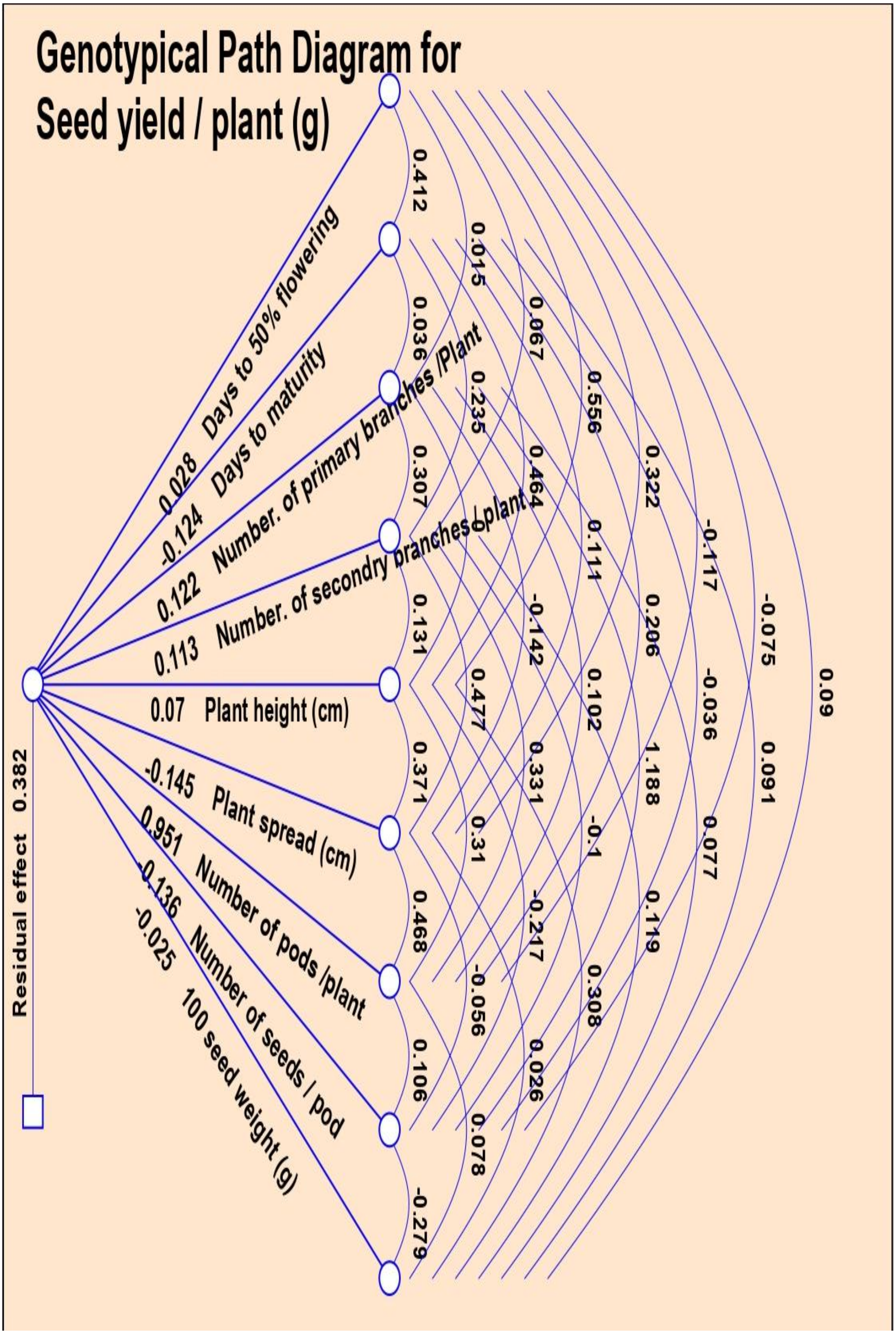

Fig 1: Typical Genotypic Path Coefficient diagram showing the relationship between quantitative traits and grain yield.

4. Conclusion

Except for days to 50% flowering, all of the variables studied in this study had a positive correlation with seed yield per plant, according to genotypic correlation coefficients. There were strong genotypic associations between seed yield per plant and the number of secondary branches per plant, plant height, plant spread, and the number of seeds per pod. Because environmental impacts are excluded, genotypic correlations across characteristics impacting seed yield per plant explain the true association. As a result, the number of secondary branches per plant, plant height, plant spread, and number of seeds per pod of the chickpea genotypes studied in this study are the best features for selection to improve seed yield per plant.

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