Original Research Article

Selection of yield contributing traits in chickpea genotypes by correlation and path analysis studies

Abstract

Identification of potent parents having particular yield contributing traits is one of the important aspects of various crops breeding programme. For this purpose a study was carried out with thirty three chickpea genotypes (including three check) in Rabi 2018-19 at Pulses Improvement Project, Mahatma Phule Krishi Vidhyapeeth, Rahuri, Maharashtra, India. Experiment was conducted on thirty three chickpea genotypes with Randomized Block Design in two replications. Each plot consisted of single row of 4 meter length with a spacing of 30 × 10 cm. Correlation studies revealed that, seed yield per plant showed high significant positive correlation with number of pods per plant, plant spread, plant height and no of secondary branches per plant, whereas, negative correlation with days to 50% flowering. 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). 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. Thus these characters could be considered as the most important for selection in order to improve the seed yield in chickpea. This experiment suggests satisfying characters should be chosen for chickpea yield improvement based on the present analysis results.

Keywords: Chickpea, *Cicer arietinum* L., genotypes, path coefficient analysis, correlation analysis, seed yield

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1. Introduction

Chickpea (*Cicer arietinum* L.) is a popular wintertime food legume with a wide geographic range. During 2017-18, globally it was grown on 149.66 lakh ha area, with the total production of 162.25 lakh tonnes (FAOSTAT, 2019) [8] and average productivity of 1252 kg/ha. Out of which, 71 per cent of global area with 70 per cent of global production of chick pea is contributed by India as it ranks 1st in area and production. The country produces around 9 million tonnes of chickpea annually, which account for about 27 percent of global imports but only 4 percent of gross supply in India, are mainly of the desi type. In contrast, Indian exports of chickpea, which constitute about 3 percent of the country's total production, are mainly of kabuli chickpea (**FAO, 2019**) [19]. Chickpea, a member of Fabaceae, is a self-pollinated true diploid (2n = 2x = 16) with genome size of 738 Mbp (Varshney *et al*., 2013a) [26]. It is an ancient annual cool season food legume crop cultivated by man and has been found in Middle Eastern archaeological sites dated 7500–6800 BC (Zohary and Hopf 2000) [28]. Its cultivation is mainly concentrated in semi-arid environments (Saxena 1990) [25].

Ladizinsky and Adler (1976) [14] considered *Cicer reticulatum* the wild progenitor of cultivated chickpea and South-Eastern Turkey as the centre of origin for the crop. Based on seed shape, size and colour, two distinct forms of cultivated chickpea are known (Cubero, 1975) [4]; namely, the desi type, characterized mostly by pink flowers, angular. brown, small seeds with a high percentage of fibre, primarily grown in South Asia and Africa; and kabuli type, having white flowers and owl-head-shaped, beige, large seeds with a low percentage of fibre, grown in Mediterranean countries. Chickpea contains 22 per cent protein, 63 per cent carbohydrates, 4.5 per cent fat, 8.0 per cent crude fibre and 27 cent ash (Miao *et al*., 2009) [15].Chickpea is low in per sodium and fat, high in protein content. They are excellent source of both soluble and insoluble fibre, complex carbohydrates, vitamins and minerals. It is rich in nutritionally important unsaturated fatty acids such as linoleic and oleic acids. β-Sitosterol, campesterol and stigmasterol are important sterols present in chickpea oil (Jukanti *et al*., 2012) [12]. Yield improvement is one of the most important considerations for a breeder. In traditional breeding method correlation and path analysis studies for yield criteria are important aspects for effective plant type selection. The correlation coefficient studies are needed to know the associations of plant characters with seed yield. For determination of the amount of direct and indirect effects of the causal components on the effect components i.e. seed yield; path analysis is studied. The path analysis is powerful tools for qualifying the degree of divergence at genotype level in respect of several traits considered together. By this analysis we can measure the divergence among the various genotypes and we can also know the direct and indirect effect of various plant characters on yield. Thus the present investigation was carried out to study the degree and direction of relationship between different characters and direct and indirect contribution of independent variables on dependent one among 33 genotypes of Chickpea.

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2. Materials and Methods

Thirty three chickpea genotypes (Table 1) including three checks *viz*., Digvijay, Vijay and Vishal were obtained from MPKV RAHURI, ARS BADNAPUR, PDKV AKOLA and Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra. The latitude and longitude of the experiment location are 19.40N and 74.80E, respectively. The mean altitude is 530 meter above mean sea level and comes under the drought prone area with average annual rainfall of 541 mm. The annual average maximum and minimum temperature ranges between 30 and 40°C and 11 to 20°C respectively. These germplasm lines were sown in Randomized Block Design with two replications during *rabi* 2018-19 at pulses research institute, Rahuri, Maharashtra. Each plot consisted of single row of 4 meter length with a spacing of 30 × 10 cm. In each row ten plants were selected for each genotypes for recording characters *viz*., days to 50 per cent 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 along with this their mean values were used for statistical analysis. Correlation was worked out according to the methods Johnson *et al.* (1955) [11] and path coefficient analysis by Dewey and Lu (1959) [7] and Wright (1921) [27]. Data analysis was done using INDOSTAT software.

Table No 1: List of thirty three genotypes of chickpea .

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Sr.No	Genotype	Sr.No.	Genotype
Source: 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

In character association studies; seed yield per plant showed high significant positive correlation with number of pods per plant (0.9097), plant spread (0.3644), plant height (0.3050) and no of secondary branches per plant (0.3888), whereas, negative correlation with days to 50% flowering (-0.1250). 100 seed weight showed high significant positive correlation with plant height (0.3084) and significant negative correlation with no of seeds per pod (-0.2790) (Table 2). Similar finding were reported by Chand and Singh, (1997) [13]; 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 exhibiting more involvement of additive genes. Significant positive correlation was noticed for no of seeds per pod with no of primary branches per plant (0.9881), whereas, negative correlation with days to 50% flowering (-0.0752), days to maturity (-0.0355), no of secondary branches per plant (-0.0996), plant height (-0.2173) and plant spread (-0.0565). Significant positive correlation was noticed for no of pods per plant with no of secondary branches per plant (0.3308), plant height (0.3097) and plant spread (0.4677), whereas, negative correlation with days to 50% flowering (-0.1168). Significant positive correlation was noticed for plant spread with days to 50% flowering (0.3224), no of secondary branches per plant (0.4767) and plant height (0.3710), whereas, negative correlation with no of primary branches per plant (-0.1423). Significant positive correlation was noticed for plant height with days to 50% flowering (0.5564) and days to maturity (0.4642), whereas, negative correlation with no of primary branches per plant (-0.0004). This results also supplements the findings of Singh *et al*. (1990) [22]. Significant positive correlation was noticed for no of secondary branches per plant with no of primary branches per plant (0.3072) and days to maturity with days to 50% flowering (0.4122). Similar results have also been reported by Dasgupta *et al*. (1992) [5]. To know the direct and indirect effects of these traits on seed yield correlations were further portioned into direct and indirect effects through path coefficient analysis (table 3). 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. Similar results have also been reported by Sozen and Karadavut (2018) [23]. 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) [6]. Thus these characters could be considered as the most important for selection in order to improve the seed yield in chickpea. Number of pods per plant is a key factor for determining the yield performance in leguminous plants as indicated by Rasul *et al*. (2012) [18].

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

Characters	Days to 50% flowering	Days to maturity	Number of primary branches plant^{1}	Number of secondary branches plant^{-1}	Plant height (cm)	Plant spread (cm)	Number of pods plant^{-1}	Number of seeds Pod^{-1}	100 seed weight (g)	Seed yield plant^{-1} (g)
Days to 50% flowering	1.0000	0.4122**	0.0150	0.0669	0.5564**	0.3224**	-0.1168	-0.0752	0.0895	-0.1250
Days to maturity	0.3798 **	1.0000	0.0364	0.2349	0.4642**	0.1113	0.2059	-0.0355	0.0907	0.1332
Number of primary branches plant^{1}	0.0291	0.0290	1.0000	0.3072*	-0.0004	-0.1423	0.1021	0.9881**	0.0769	0.1078
Number of secondary branches plant^{-1}	0.0028	0.2135	-0.0333	1.0000	0.1311	0.4767**	0.3308**	-0.0996	0.1193	0.3888**
Plant height (cm)	0.4945 **	0.4420**	-0.1046	0.1815	1.0000	0.3710**	0.3097**	-0.2173	0.3084**	0.3050**
Plant spread (cm)	0.2080	0.1017	-0.2139	0.4871 **	0.3633 **	1.0000	0.4677**	-0.0565	0.0256	0.3644**
Number of pods plant^{-1}	-0.1204	0.1964	0.0025	0.3344 **	0.3204 **	0.4436 **	1.0000	0.1059	0.0784	0.9097**
Number of seeds Pod^{-1}	-0.0739	-0.0026	0.1855	0.0983	-0.0640	0.0510	0.0838	1.0000	-0.2790*	0.1017
100 seed weight (g)	0.0706	0.0838	-0.0267	0.1535	0.3219 **	0.0503	0.0901	-0.1344	1.0000	0.1193
Seed yield plant^{-1}	-0.1403	0.1194	0.0030	0.3770**	0.3156**	0.3465**	0.9017**	0.0903	0.1343	1.0000

*, ** indicate significant at 5 and 1 per cent level, respectively

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

Sr. No.	Characters	Days to 50% flowering	Days to maturity	Number of primary branches plant^{1}	Number of secondary branches plant^{-1}	Plant height (cm)	Plant spread (cm)	Number of pods plant^{-1}	Number of seeds Pod^{-1}	100 seed weight (g)	Total genotypic correlation with seed yield per plant
1	**Days to 50% flowering**	<u>**0.0277**</u>	-0.0511	0.0018	0.0076	0.0389	-0.0467	-0.1111	0.0102	-0.0022	-0.120
2	**Days to maturity**	0.0114	<u>**-0.1239**</u>	0.0045	0.0266	0.0324	-0.011	0.1958	0.0048	-0.0023	0.1332
3	**Number of primary branches plant^{1}**	0.0004	-0.0045	<u>**0.1225**</u>	0.0348	0.000	0.0206	0.0971	-0.1611	-0.0019	0.1078
4	**Number of secondary branches plant^{-1}**	0.0019	-0.0291	0.0376	<u>**0.1132**</u>	0.0092	-0.0691	0.3146	0.0135	-0.0030	0.3888
5	**Plant height (cm)**	0.0154	-0.0575	0.000	0.0148	<u>**0.0699**</u>	-0.0538	0.2945	0.0295	-0.0077	0.3050
6	**Plant spread (cm)**	0.0089	-0.0138	0.0174	0.0540	0.0259	<u>**-0.1450**</u>	0.4448	0.0077	-0.0006	0.3644
7	**Number of pods plant^{-1}**	-0.0032	-0.0255	0.0125	0.0375	0.0216	-0.0678	<u>**0.9510**</u>	-0.0144	-0.0020	0.9097**
8	**Number of seeds Pod^{-1}**	0.0021	0.0044	0.1455	-0.0113	0.0152	0.0082	0.1007	<u>**-0.1356**</u>	0.0070	0.1017
9	**100 seed weight (g)**	0.005	-0.0112	0.0094	0.0135	0.0215	-0.007	0.0746	0.0378	<u>**-0.0251**</u>	0.1193

Underlined figures indicate direct effect.

*, ** indicate significant at 5 and 1 per cent level, respectively

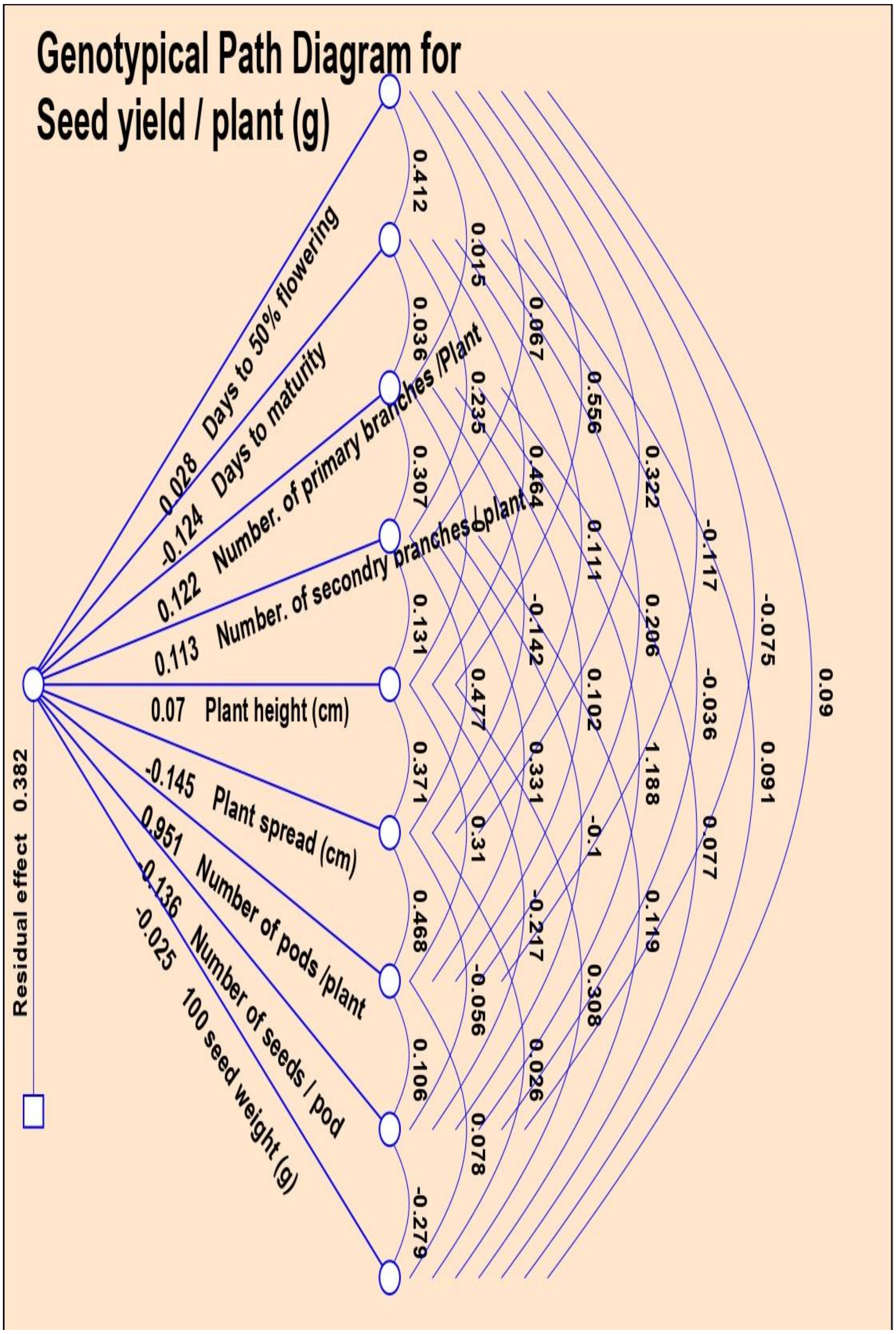

Fig 1: Genotypical Path Diagram.

4. Conclusion

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Emphasis should be given while making selection for number of pods per plant, 100 seed weight, plant height and number of secondary branches per plant as these traits also showed significant positive association with seed yield per plant. So that selection for high seed yield should be based on biomass (biological yield) and harvest index in chickpea. The seed yield in chickpea can be improved by selecting an ideotype having higher number of pods per plant as well as greater plant height and 100 seed weight.

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