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RESEARCH PAPER

Path analysis studies for yield and yield attributing characters in chickpea (*Cicer arientinum* L.) germplasm

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Abstract : The path co-efficient analysis in chickpea indicated that the characters *viz.,* 100 seed weight, number of pods per plant, number of secondary branches per plant, days to 50% flowering, harvest index and number of primary branches per plant on seed yield were the major yield contributing traits in chickpea. Therefore, the selection of genotypes based on these characters as a selection criterion would help to improve the seed yield potential of chickpea.

Key Words : Studies for yield, Yield attributing characters, Chickpea

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INTRODUCTION

Chickpea (*Cicer arietinum* L.), is anautogamous legume crop with chromosome no. 2n = 14 or 2n = 16 with a considerable diversity present among the 44 annual Cicer species. A large collection of chickpea germplasm including wild *Cicer* species has been conserved in different gene banks globally. To enhance the production of chickpea legume, different phenotypical characters are being considered. The path coefficient analysis of grain yield components brings out the relative importance of their direct and indirect effects and gives a clear understanding of their association with grain yield. Selection on the basis of direct and indirect effects is much more useful than selection for seed yield.

MATERIAL AND METHODS

The research trials were conducted during *Rabi* season of 2021-2022 at the College of Agriculture, VNMKV, Badnapur campus, Maharashtra to estimate the genetic diversity among the chickpea genotypes. The breeding material consisted of 41 diverse genotypes of chickpea including the five standard checks *viz*. Akash (BDNG-797), Digvijay, Vijay, PhuleVikram and JAKI 9218. These genotypes were evaluated in Randomized Block Design (RBD) with two replications.Genotypes were sown in one row of 4 m length with the spacing of 45 cm for row to row and 10 cm for plant to plant. Observations were recorded for ten traits *viz.*, days to 50% flowering, days to maturity, plant height, number of primary branches per plant, number of secondary

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branches per plant, number of pods per plant, number of seeds per pod, 100 seed weight, seed yield per plant and harvest index.

To establish a cause and effect relationship the first step used was to partition the genotypic and phenotypic correlation co-efficient into direct and indirect effects by path analysis as suggested by Dewey and Lu (1959) and developed by Wright (1921).

RESULTS AND DISCUSSION

Path co-efficient analysis provides a thorough understanding of contribution of various characters by partitioning the correlation co-efficient into components of direct and indirect effects (Wright, 1921), which helps the breeder in determining the yield components. Therefore, Path co-efficient analysis was used to determine the direct and indirect effects of each of the characters on seed yield per plant. The phenotypic and genotypic correlation coefficients, which are more important was partitioned into direct and indirect effects (Table 1 and 2, Fig.1 and 2).

Studies on direct effect:

Among all the components at phenotypic level, 100 seed weight exhibited the highest positive direct effect (p=0.6847) on seed yield followed by number of pods per plant (p=0.6766), number of secondary branches per plant (p=0.1033), days to 50% flowering (p=0.0443), harvest index (p=0.0328) and number of primary branches per plant (p=0.0327). While plant height (p= -0.1168) and days to maturity (p=- 0.0094) recorded negative direct effect.

At genotypic level, 100 seed weight exhibited the highest positive direct effect (g=0.8867) on seed yield followed by number of pods per plant (g=0.6922), days to 50% flowering (g=0.2045), number of primary branches (g=0.0839) and number of secondary branches per plant (g=0.0791). While plant height (g= -0.1901), days to maturity (g= -0.0634) and harvest index (g=-0.0555) recorded negative direct effect.

Studies on indirect effect:

Days to 50% flowering :

Days to 50% flowering had negative phenotypic and genotypic correlation (p= -0.1278;g= -0.1400) with seed yield per plant.It exhibited negative indirect effects through number of pods per plant (p=-0.0657; g=-0.0868) followed by 100 seed weight (p=-0.0587; g=-0.0832), plant height (p=-0.0219; g=-0.0407), number of primary branches (p=-0.0081; g=-0.0249), number of secondary branches (p=-0.0076; g=-0.0078), number of seeds per pod (p=-0.0073; g=-0.0474) and days to maturity (p=-0.0055; g=-0.0417). It showed positive indirect effect at phenotypic level through harvest index (p=0.0026) and negative at genotypic level (g=-0.0119). Thus these indirect causal factors are to be considered during selection process for improving seed yield per plant.

Table 1 : Direct and indirect effect of yield and its component characters on seed yield at phenotypic level in chickpea

Sr. No.	Characters	Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of primary branches / plant	Number of secondary branches / plant	Number of pods / plant	Number of seeds /pod	100 seed weight (g)	Harvest index (%)	Total phenotypic correlation with seed yield / plant (g)
1.	Days to 50 % flowering	0.0443	0.0258	0.0083	-0.0110	-0.0033	-0.0043	0.0125	-0.0038	0.0035	-0.1278
2.	Days to maturity	-0.0055	-0.0094	-0.0037	0.0013	0.0004	0.0003	-0.0013	-0.0021	-0.0022	0.0969
3.	Plant height (cm)	-0.0219	-0.0460	-0.1168	0.0125	-0.0188	-0.0204	-0.0165	-0.0555	-0.0242	0.3480
4.	No. of primary Branches per plant	-0.0081	-0.0045	-0.0035	0.0327	0.0070	-0.0069	0.0013	-0.0027	-0.0042	-0.1476
5.	No. of secondary Branches per plant	-0.0076	-0.0043	0.0166	0.0220	0.1033	0.0291	0.0049	0.0122	0.0109	0.3623
6.	Number of pods per plant	-0.0657	-0.0202	0.1184	-0.1425	0.1905	0.6766	-0.1599	-0.0396	0.1734	0.6488
7.	Number of seeds per pod	-0.0073	-0.0035	-0.0037	-0.0010	-0.0012	0.0061	-0.0260	-0.0022	0.0031	-0.1316
8.	100 seed weight(g)	-0.0587	0.1515	0.3255	-0.0573	0.0810	-0.0401	0.0573	0.6847	0.3242	0.6065
9.	Harvest index(%)	0.0026	0.0076	0.0068	-0.0042	0.0035	0.0084	-0.0039	0.0155	0.0328	0.5174

Residual effect = 0.3742, Underlined figures indicate direct effect

Table 2 : Direct and indirect effect of yield and its component characters on seed yield at genotypic level in chickpea

Sr. No.	Characters	Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of primary branches / plant	Number of secondary branches / plant	Number of pods / plant	Number of seeds /pod	100 seed weight (g)	Harvest index (%)	Total phenotypic correlation withseed yield / plant (g)
1.	Days to 50 % flowering	0.2045	0.1346	0.0437	-0.0608	-0.0203	-0.0257	0.0711	-0.0192	0.0439	-0.1400
2.	Days to maturity	-0.0417	-0.0634	-0.0264	0.0120	0.0058	0.0042	-0.0107	-0.0151	-0.0241	0.0906
3.	Plant height (cm)	-0.0407	-0.0793	-0.1901	0.0229	-0.0363	-0.0331	-0.0274	-0.0965	-0.0637	0.3649
4.	No. of primary Branches per plant	-0.0249	-0.0158	-0.0101	0.0839	0.0183	-0.0203	0.0051	-0.0070	-0.0203	-0.1613
5.	No. of secondary Branches per plant	-0.0078	-0.0073	0.0151	0.0173	0.0791	0.0202	-0.0006	0.0130	0.0051	0.3662
6.	Number of pods per plant	-0.0868	-0.0462	0.1206	-0.1673	0.1766	0.6922	-0.2396	-0.0434	0.2441	0.6096
7.	Number of seeds per pod	-0.0474	-0.0230	-0.0197	-0.0084	0.0010	0.0472	-0.1365	-0.0168	0.0388	-0.2133
8.	100 seed weight(g)	-0.0832	0.2120	0.4502	-0.0743	0.1454	-0.0556	0.1094	0.8867	0.5625	0.6664
9.	Harvest index(%)	-0.0119	-0.0211	-0.0186	0.0134	-0.0036	-0.0196	0.0158	-0.0352	-0.0555	0.7310

Residual effect = 0.2946, Underlined figures indicate direct effect

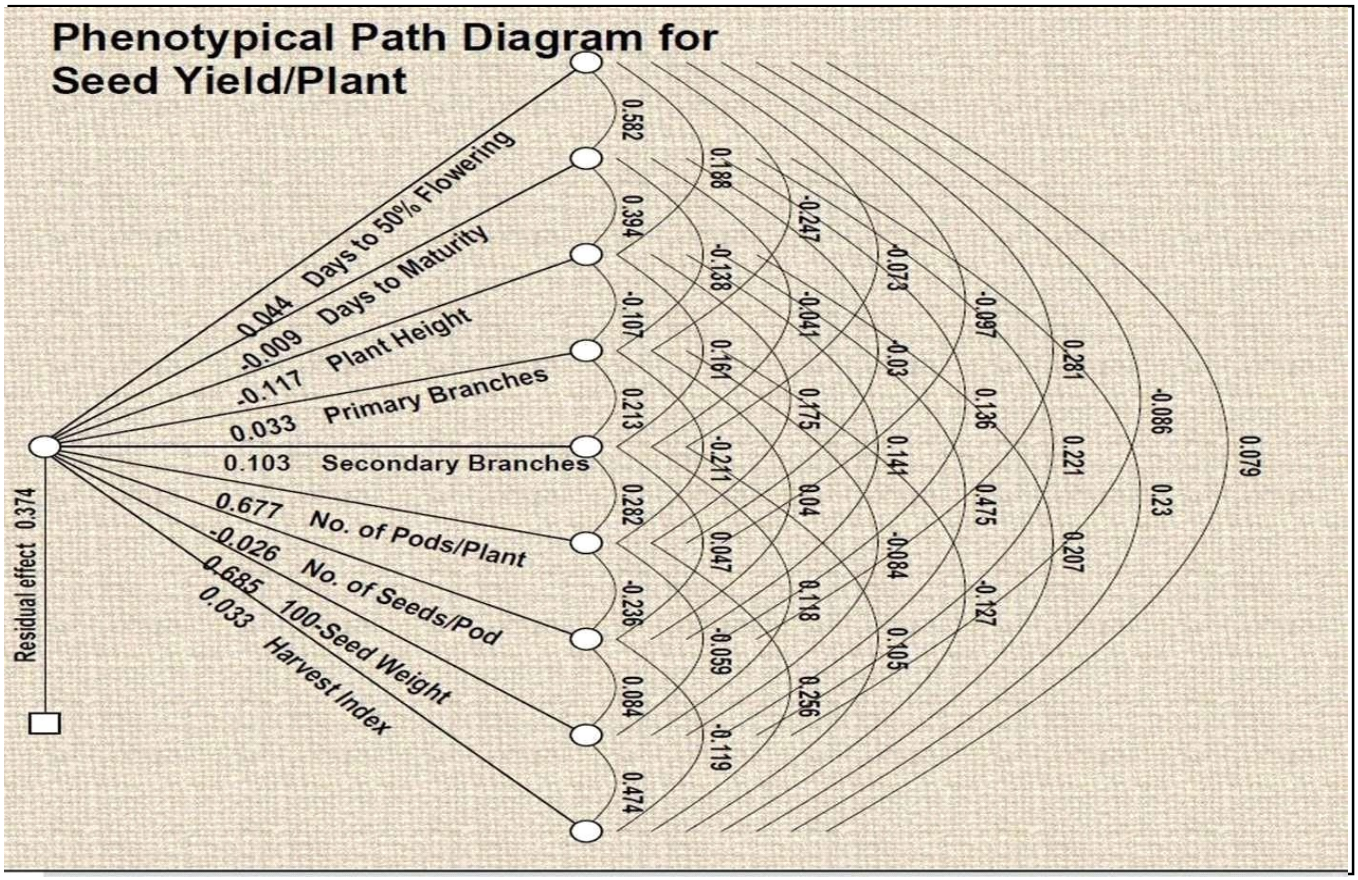

Fig. 1: Direct and indirect effect of yield and its component characters on seed yield at phenotypic level in chickpea

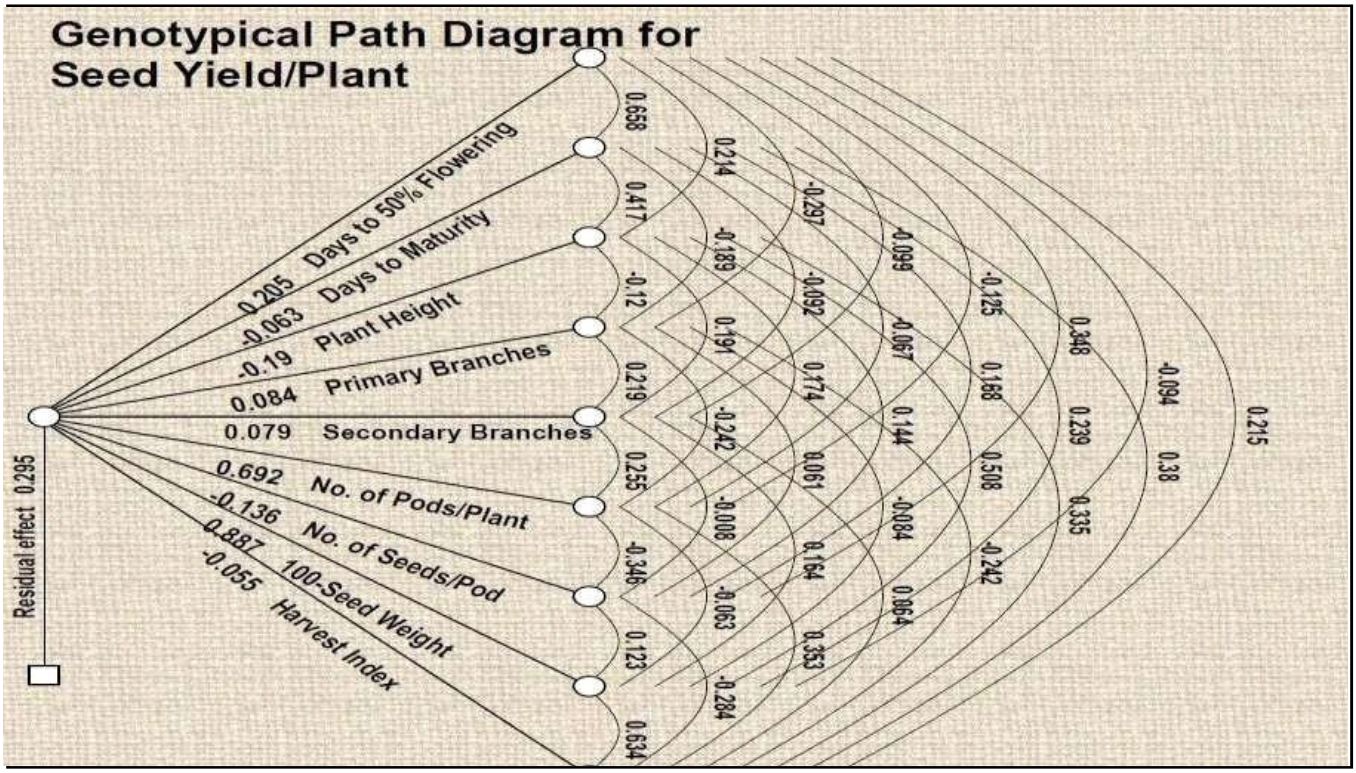

Fig. 2 : Direct and indirect effect of yield and its component characters on seed yield at genotypic level in chickpea

Days to maturity :

Days to maturity had positive phenotypic and genotypic correlation (p=0.0969; g=0.0906) with seed yield per plant. It exhibited positive indirect effects through 100 seed weight (p=0.1515; g=0.2120) and days to 50% flowering (p=0.0258; g=0.1346), while negative indirect effect through plant height (p=-0.0460; g=-0.0793), number of pods per plant (p=-0.0202; g=-0.0462), number of primary branches (p=-0.0045;g=-0.0158), number of secondary branches (p=-0.0043;g=- 0.0073), and number of seeds per pod (p=-0.0035;g=-0.0230) at both phenotypic and genotypic level. It showed positive indirect effect through harvest index (p=0.0076) at phenotypic level and negative indirect effect at genotypic level (g=- 0.0211).

Plant height :

Plant height showed positive phenotypic and positive genotypic correlation (p=0.3480; g=0.3649) with seed yield per plant.It has positive indirect effect through 100 seed weight (p=0.3255; g=0.4502), number of pods per plant (p=01184; g=0.1206) and number of secondary branches per plant (p=0.0166; g=0.0151), days to 50% flowering (p=0.0083; g=0.0467) and negative indirect effect through days to maturity (p=-0.0037; g=-0.0264), number seeds per pod (p=-0.0037; g=-0.0197) and number of primary branches (p=-0.0035; g=-0.0101) at both phenotypic and genotypic level. It showed positive indirect effect through harvest index (p=0.0068) at phenotypic level and negative indirect effect (g=-0.0186) at genotypic level.

Number of primary branches per plant :

Number of primary branches per plant showed negative phenotypic and genotypic correlation (p=-0.1476; g=-0.1613) with seed yield per plant. It showed positive indirect effects at both phenotypic and genotypic level through number of secondary branches (p=0.0220; g=0.0173), plant height (p=0.0125; g=0.0229) and days to maturity (p=0.0013; g=0.0120).

Number of secondary branches per plant :

Number of secondary branches per plant had positive phenotypic and genotypic correlation (p=0.3623; g=0.3662) with seed yield per plant.It showed positive indirect effects through number of pods per plant (p=0.1905; g=0.1766), 100 seed weight (p=0.0810; g=0.1454), number of primary branches (p=0.0070;

g=0.0183) and days to maturity (p=0.0004; g=0.0183) and negative indirect effect through number of plant height (p=-0.0188; g=-0.0363) and days to 50% flowering (p=-0.0033; g=-0.0203) at both phenotypic and genotypic level.

Number of pods per plant :

Number of pods per plant had positive phenotypic and genotypic correlation (p=0.6488; g=0.6096) with seed yield per plant. It showed positive indirect effect through number of secondary branches per plant (p=0.0291; g=0.0202), number of seeds per pod (p=0.0061; g=0.0472) and days to maturity (p=0.0003; g=0.0042) and negative indirect effect through 100 seed weight (p=-0.0401; g=-0.0556), plant height (p=-0.0204; g=-0.0331), number of primary branches (p=-0.0069; g=-0.0203), days to 50% flowering (p=-0.0043; g=-0.0257) at both phenotypic and genotypic level.

Number of seeds per pod :

Number of seeds per pod had negative phenotypic and genotypic correlation (p=-0.1316; g=-0.2133) with seed yield per plant. Number of seeds per pod showed positive indirect effect through 100 seed weight (p=0.0573; g=0.1094), days to 50% flowering (p=0.0125; g=0.0711) and number of primary branches (p=0.0013; g=0.0051) and negative indirect effect through number of pods per plant (p=-0.1599; g=-0.2396), plant height (p=-0.0165; g=-0.0274) and days to maturity (p=-0.0013; g=- 0.0107) at both phenotypic and genotypic level.

100 seed weight :

100 seed weight had positive phenotypic and genotypic correlation (p=0.6065; g=0.6664) with seed yield per plant. It showed positive indirect effect through number of secondary branches per plant (p=0.0122; g=0.0130) and negative indirect effect through plant height (p=-0.0555; g=-0.0965), number of pods per plant (p=-0.0396 ; g=-0.0434), days to 50% flowering (p=-0.0038; g=-0.0192), number of primary branches per plant (p=-0.0027; g=-0.0070), number of seeds per pod (p=-0.0022; g=- 0.0168) and days to maturity (p=-0.0021; g=-0.0151) at both phenotypic and genotypic level. It showed positive indirect effect through harvest index (p=0.0155) at phenotypic level and negative at genotypic level (g=-0.0352).

Harvest index :

Harvest index had positive phenotypic and genotypic correlation (p=0.5174; g=0.7310) with seed yield per plant. It exhibited positive indirect effect through 100 seed weight (p=0.3242; g=0.5625), number of pods per plant (p=0.1734; g=0.2441), number of secondary branches per plant (p=0.0109; g=0.0051), days to 50% flowering (p=0.0035; g=0.0439) and number of seeds per pod (p=0.0031; g=0.0388) and negative effect through plant height (p=-0.0242 g=-0.0637), primary branches per plant (p=-0.0042; g=-0.0203) and days to maturity (p=-0.0022 g=- 0.0241) at both phenotypic and genotypic level.

The characters *viz.,* 100 seed weight, number of pods per plant, number of secondary branches per plant, days to 50% flowering, harvest index and number of primary branches per plant have a direct effecton seed yield in decreasing order of magnitude revealing that these were major yield contributing traits in chickpea.

Similar results were reported by Talebi *et al.* (2007) for number of seeds per pod, number of pods per plant and harvest index. Thakur and Sirohi (2009) reported the highest positive direct effect of harvest index and number of pods per plant on grain yield. Harvest index showed a positive direct effect on seed yield as reported by Ozveren and Anlarsal (2010), Yucel and Anlarsel (2010) and Chopdar *et al.* (2016). Number of pods per plant had also a direct effect on grain yield as reported by Gaikwad and Monpara (2011). Zali *et al.* (2011) recorded number of secondary branches per plant which had a positive direct effect on grain yield. Kumar *et al.* (2012) reported the highest positive direct effect of number of pods per plant on seed yield.

Conclusion :

The path co-efficient analysis indicate that the phenotypic characters *like* 100 seed weight, number of pods per plant, number of secondary branches per plant, days to 50% flowering, harvest index and number of primary branches per plant affect the seed yield in chickpea and that these phenotypical characters were major yield contributing traits in chickpea. Hence, the selection of genotypes based on these characters as a selection criterion would help to improve the seed yield potential of chickpea.

Acknowlegdement:

Conflict of Interest: There is no conflict of interest

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