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Genetic association and direct-indirect effects of yield components in chickpea (*Cicer arietinum* L.): A correlation and path coefficient study

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Abstract
The current research took place in the Rabi season of 2024-25 at the Genetics and Plant Breeding Research Farm, Deen Dayal Upadhyaya Gorakhpur University, located in Uttar Pradesh, India. To assess twenty chickpea genotypes alongside two control varieties (BG 1003 and BG 256) for yield and related traits. The study was conducted using a Randomized Block Design, and information was gathered on eleven characteristics such as days to 50% flowering, days to maturity, plant height, primary and secondary branches per plant, pods per plant, seeds per pod, biological yield, weight of 100 seeds, harvest index, and seed yield per plant. Correlation analysis showed that genotypic correlations tended to exceed phenotypic correlations, signifying stronger genetic connections than those seen phenotypically, implying that environmental influences diminish the manifestation of genuine genetic relationships. Characteristics like biological yield, harvest index, primary branch count, pods per plant, and secondary branch count exhibited highly significant and positive correlations with seed yield per plant. Path coefficient analysis indicated that both the harvest index and biological yield per plant had the strongest positive direct effects on seed yield at both the phenotypic and genotypic levels, followed by traits such as 100-seed weight, pods per plant, and others contributing to yield. Significantly, days to 50% flowering showed strong positive indirect influences through biological yield and harvest index. These results indicate that choosing based on harvest index, biological yield, and associated traits can successfully improve seed yield in chickpea.

Keywords: Chickpea, correlation coefficient, path coefficient, seed yield, yield related traits

Introduction
One of the most important pulse crops in the world, chickpea (*Cicer arietinum* L.), or garbanzo bean, is one of the most nutritionally rich and adaptable pulse crops to a variety of agro-climatic conditions. Chickpea belongs to the Fabaceae family and is the second most commonly grown legume after common bean (*Phaseolus vulgaris*) and is a major source of protein, dietary fiber, vitamins, and minerals in vegetarian and vegan diets (Jukanti *et al.*, 2012) [1]. The major producers of chickpea are India, Australia, Turkey, and Myanmar (FAOSTAT, 2023) [2]. It is divided into two main types: Desi (small-seeded, colored) and Kabuli (large-seeded, cream-colored), each with different agronomic and nutritional characteristics (Upadhyaya *et al.*, 2017) [13]. The nutritional value of chickpea seeds is about 20-22% protein, 60-65% carbohydrates, and significant amounts of iron, zinc, folate, and antioxidants. It is also good for treating diabetes and cardiovascular diseases, as it has a low glycemic index and high fiber content. Chickpea also provides a source of nitrogen for sustainable agriculture, because it is nitrogen-fixing, which increases soil fertility and reduces the need for synthetic fertilizers (Stagnari *et al.*, 2017) [11].

Materials and Methods
This study was carried out in Uttar Pradesh, India, at the Genetics and Plant Breeding Research Farm at Deen Dayal Upadhyaya Gorakhpur University in Hirapuri. Twenty different chickpea genotypes (BG 2030, BG 2061, BG 2088, BG 3011, BG 3013, BG 3014, BG 372, ICCV 03111, ICCV 04105, ICCV 04312, ICCV 05109, ICCV 05314, ICCV 96792, ICCV 10, JG 19, JG 22, JG 14-11, JG 9-3, ICC 3137, ICC 4934) and two well-known check

varieties (BG 1003 and BG 256) were evaluated as part of the study. A Randomized Block Design was used to ensure unbiased results during the Rabi season of 2024-2025. Five healthy plants were randomly chosen from each plot, and observations were made on eleven distinct characteristics, including the number of days until 50% flowering, the number of days until maturity, the height of the plant (cm), the number of primary and secondary branches per plant, the number of pods per plant, the number of seeds per pod, the biological yield per plant (g), the 100-seed weight (g), the Harvest Index (%), and the number of seeds per plant**.** In order to measure these relationships and guide effective selection, correlation analysis is a useful tool. Designing better breeding strategies for high-yielding varieties requires an understanding of how these traits relate to one another and to overall yield. The path coefficient analysis broke down these relationships into direct and indirect effects, assisting in determining which traits had the greatest influence on seed yield. The correlation coefficient measured the degree of association between various traits and grain yield in crops.

Results and Discussion

The correlation coefficient measured the degree of association between different traits and grain yield in crops and path coefficient analysis then decomposed these relationships into direct and indirect effects, helping identify which traits most influenced the seed yield in chickpea.

Correlation coefficient analysis

According to the study, chickpeas exhibited stronger genetic associations than those expressed phenotypically, with genotypic correlations typically higher than corresponding phenotypic correlations. This implies that observable phenotypic relationships are weakened by environmental factors, which modulate trait expression. In contrast to the phenotypic coefficient of correlation, which was found to be highly significant with regard to the number of primary branches, pods per plant, biological yield, and harvest index, the primary branches per plant, secondary branches per plant, and pods per plant all showed highly significant positive correlations with seed yield per plant. These findings were also found by Kumar *et al.* (2015) [6, 7], Patil *et al.* (2016) [8], Singh *et al.* (2017) [5].

Path coefficient analysis

The phenotypic path coefficient analysis showed that all ten traits harvest index followed by biological yield, 100 seed weight, pods per plant, plant height, days to 50% flowering, seeds per pod, number of secondary branches, days to maturity, and number of primary branches have had a positive and direct effect on seed yield per plant. Days to 50% flowering has a strong indirect positive effect on seed yield per plant, primarily through biological yield and harvest index. Similar results were reported by the Ali *et al.* (2010) [1] and Kumar *et al.* (2015) [6, 7]. The analysis of genotypic path coefficients revealed that the harvest index had the greatest direct and positive impact on seed yield per plant, followed by biological yield per plant, 100-seed weight, pods per plant, seeds per pod, days to 50% flowering, plant height, secondary branches per plant, and days to maturity. Primary branches per plant had a slight negative direct effect. Harvest indices through primary branches and days to 50% flowering had the greatest indirect effects of genotypic path coefficient on seed yield. These findings were also found by Kumar *et al.* (2017) [5], Suman *et al.* (2023) [12], Khan *et al.* (2025) [4].

Table 1: Estimates of phenotypic and genotypic correlation coefficients between eleven characters in chickpea genotypes.

Traits		Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches per plant	Secondary branches per plant	Pods per plant	Seeds per pod	Biological Yield per plant (g)	100 seed weight (g)	Harvest Index (%)	Seed yield per plant (g)
Days to 50% flowering	P		0.9294 **	-0.37 **	-0.0475	-0.0147	0.1072	-0.1452	0.1898	-0.0427	0.2727 *	0.2917 *
	G		0.9328 **	-0.3752	-0.0499	-0.0146	0.1077	-0.147	0.1913	-0.0426	0.2733	0.2926
Days to maturity	P			-0.4253 **	-0.0406	0.0031	0.0676	-0.1257	0.1531	-0.0372	0.2243	0.2387
	G			-0.4322 *	-0.0443	0.0051	0.068	-0.1268	0.1551	-0.0371	0.2251	0.2398
Plant height (cm)	P				0.0373	0.0379	0.1211	0.2121	0.0163	-0.0967	-0.0471	-0.0243
	G				0.0418	0.0358	0.1215	0.2148	0.0177	-0.098	-0.0468	-0.0238
Primary branches per plant	P					0.5046 **	0.6835 **	0.11	0.1987	-0.089	0.5409 **	0.5273 **
	G					0.5166 *	0.697 **	0.1103	0.2027	-0.0916	0.551 **	0.5372 **
Secondary branches per plant	P						0.5974 **	-0.0682	0.2706 *	0.2214	0.398 **	0.4445 **
	G						0.5994 **	-0.0644	0.2723	0.2222	0.3987	0.4457 *
Pods per plant	P							0.0519	0.4612 **	-0.1328	0.7859 **	0.8186 **
	G							0.052	0.4618 *	-0.1328	0.7867 **	0.8193 **
Seeds per pod	P								-0.0641	-0.7748 **	0.282 *	0.194
	G								-0.0659	-0.7822 **	0.2845	0.1952
Biological yield per plant (g)	P									0.1609	0.3378 **	0.6001 **
	G									0.1609	0.3385	0.6005 **
100 seed weight (g)	P										-0.2272	-0.1069
	G										-0.2274	-0.107
Harvest Index (%)	P											0.9531 **
	G											0.9532 **

Table 2: Direct and indirect effect of 10 characters on seed yield per plant in chickpea.

Traits		Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches per plant	Secondary branches per plant	Pods per plant	Seeds per pod	Biological yield per plant (g)	100 seed weight (g)	Harvest Index (%)	Seed yield per plant (g)
Days to 50% flowering	P	0.0123	0.0023	-0.0056	0.0000	-0.0001	0.0024	-0.0017	0.0559	-0.0021	0.2283	0.2917
	G	0.01452	0.00119	-0.00528	0.00005	-0.0001	0.00293	-0.0025	0.05614	-0.00225	0.22793	0.29263
Days to maturity	P	0.0114	0.0025	-0.0064	0.0000	0.0000	0.0015	-0.0015	0.0451	-0.0018	0.1878	0.2386
	G	0.01355	0.00127	-0.00608	0.00004	0.00003	0.00185	-0.00216	0.04551	-0.00196	0.18776	0.23982
Plant height (cm)	P	-0.0045	-0.0011	0.0151	0.0000	0.0003	0.0027	0.0025	0.0048	-0.0047	-0.0394	-0.0243
	G	-0.00545	-0.00055	0.01406	-0.00004	0.00023	0.00331	0.00365	0.00518	-0.00518	-0.03899	-0.02376
Primary branches per plant	P	-0.0006	-0.0001	0.0006	0.0006	0.0038	0.0153	0.0013	0.0585	-0.0043	0.4528	0.5279
	G	-0.00072	-0.00006	0.00059	-0.00096	0.00336	0.01897	0.00188	0.05948	-0.00484	0.45948	0.53717
Secondary branches per plant	P	-0.0002	0.0000	0.0006	0.0003	0.0076	0.0134	-0.0008	0.0797	0.0107	0.3333	0.4446
	G	-0.00021	0.00001	0.0005	-0.0005	0.00651	0.01631	-0.0011	0.07992	0.01173	0.33249	0.44567
Pods per plant	P	0.0013	0.0002	0.0018	0.0004	0.0045	0.0225	0.0006	0.1359	-0.0064	0.6578	0.8186
	G	0.00156	0.00009	0.00171	-0.00067	0.0039	0.02721	0.00089	0.13553	-0.00701	0.65605	0.81926
Seeds per pod	P	-0.0018	-0.0003	0.0032	0.0001	-0.0005	0.0012	0.0117	-0.0193	-0.0375	0.2361	0.1929
	G	-0.00214	-0.00016	0.00302	-0.00011	-0.00042	0.00142	0.01701	-0.01935	-0.04132	0.23724	0.19519
Biological yield per plant (g)	P	0.0023	0.0004	0.0003	0.0001	0.0021	0.0104	-0.0008	0.2947	0.0078	0.2828	0.6000
	G	0.00278	0.0002	0.00025	-0.00019	0.00177	0.01257	-0.00112	0.29347	0.0085	0.2823	0.60052
100 seed weight (g)	P	-0.0005	-0.0001	-0.0015	-0.0001	0.0017	-0.0030	-0.0091	0.0474	0.0484	-0.1902	-0.1069
	G	-0.00062	-0.00005	-0.00138	0.00009	0.00145	-0.00361	-0.01331	0.04721	0.05282	-0.18962	-0.10701
Harvest Index (%)	P	0.0034	0.0006	-0.0007	0.0003	0.0030	0.0176	0.0033	0.0996	-0.0110	0.8371	0.9531
	G	0.00397	0.00029	-0.00066	-0.00053	0.0026	0.02141	0.00484	0.09934	-0.01201	0.83396	0.9532

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Conclusion

The results of a correlation study showed that a higher genotypic correlation than a phenotypic correlation indicates a strong and less environment-influenced underlying genetic association between two traits, whereas a lower phenotypic correlation suggests that environmental factors are masking or reducing the expression of the true genetic relationship. In addition, the phenotypic path coefficient indicates that HI, BY, HSW, PPP, PH, DFF, SPP, NSB, DTM, and NPB have a positive and direct impact on seed yield per plant, whereas the genotypic path coefficient indicates that HI, BY, HSW, PPP, SPP, DFF, PH, NSB, DTM, and NPB have a positive and direct impact on seed yield, while NPB has a negative direct effect.

References

1. Ali MB, Singh KB, Ahmed N. Path coefficient analysis in chickpea (*Cicer arietinum* L.) under rainfed conditions. Journal of Agricultural Science. 2010;148(4):487-494.
2. FAOSTAT. Food and Agriculture Organization of the United Nations. 2023. Available from: http://www.fao.org/faostat
3. Jukanti AK, Gaur PM, Gowda CLL, Chibbar RN. Nutritional quality and health benefits of chickpea (*Cicer arietinum* L.). British Journal of Nutrition. 2012;108(S1):S11-S26.
4. Khan MI, Sharma P, Meena HP, Yadav VK. Genetic evaluation of chickpea genotypes for yield and its components under rainfed conditions. Journal of Agri Search. 2025;12(1):20-25.
5. Kumar A, Singh D, Singh AK, Singh VK. Genetic variability and path analysis in chickpea (*Cicer arietinum* L.). Legume Research-An International Journal. 2017;40(1):131-134.
6. Kumar J, Basu PS, Srivastava E. Genetic variability and association studies in chickpea (*Cicer arietinum* L.) under normal and late sown conditions. Indian Journal of Genetics and Plant Breeding. 2015;75(2):181-187.
7. Kumar J, Srivastava R, Ganesh M. Path analysis for yield and its components in chickpea (*Cicer arietinum* L.). Legume Research. 2015;38(1):67-71.
8. Patil SS, Salimath PM, Patil BC. Genetic divergence, variability and correlation studies in chickpea (*Cicer arietinum* L.). Electronic Journal of Plant Breeding. 2016;7(1):234-239.
9. Singh KB. Chickpea (*Cicer arietinum* L.). Field Crops Research. 1997;53(1-3):161-170.
10. Singh M, Rani U, Kumar S. Correlation and path coefficient analysis for yield and its components in chickpea (*Cicer arietinum* L.). [Journal name, volume, pages missing — please provide for formatting].
11. Stagnari F, Maggio A, Galieni A, Pisante M. Multiple benefits of legumes for agriculture sustainability. Chemical and Biological Technologies in Agriculture. 2017;4(1):2-13.
12. Suman S, Shukla DK, Mishra R. Correlation and path analysis in chickpea (*Cicer arietinum* L.) for seed yield and its components. International Journal of Plant & Soil Science. 2023;35(24):123-130.
13. Upadhyaya HD, Bajaj D, Das S, *et al.* Genetic dissection of seed-iron and zinc concentrations in chickpea. Scientific Reports. 2017;7(1):1-12.