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## TO ANALYZE THE CORRELATION COEFFICIENT AND PATH ANALYSIS RELATIONSHIP OF YIELD AND YIELD ATTRIBUTING TRAITS IN CORIANDER

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### ABSTRACT

The field experiment was carried out during 2022-23 in *Rabi* season the permanent experimental area (PEA) of Muraul farm, affiliated with the Department of Horticulture at Tirhut College of Agriculture, Dholi, Muzaffarpur, under Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar (India). The study involved thirty coriander genotypes and employed a Randomized Block Design with three replications. The results showed a highly significant correlation between grain production per plant and several factors: the number of primary branches per plant (0.2916), days to maturity (0.3735), number of secondary branches per plant (0.4472), days to 50 percent flowering (0.3775), number of umbellets per umbel (0.5656), number of umbels per plant (0.3704), the number of grains per umbel (0.5397), biological yield (0.8645), and harvest index (%) (0.3350). Path coefficient analysis indicated that biological yield (0.96638) exerted the most substantial direct impact on seed yield, followed by the harvest index (0.50693), number of grains per umbel (0.0023), number of umbels per plant (0.01162), and the number of umbellets per umbel (0.00127). As a result, these qualities ought to be given top priority when choosing for increased yield and related characteristics.

**Key words:** Correlation coefficient, path analysis, coriander, yield attributing traits

### Introduction

Coriander (*Coriandrum sativum* L.) is a spice crop of significant value, with a historical lineage tracing back to 5000 BC (Arora *et al.*, 2021; Al-Snafi, 2016). This annual spice crop, belonging to the Apiaceae family, is characterized by a chromosome number of  $2n=22$  and reproduces through cross-pollination. Coriander originates

in the Mediterranean region and was one of the first flavoring agents used by humans and has since gained prominence in countries such as India, Russia, Morocco, Hungary, Romania, Poland, Guatemala, Mexico, Turkey, and Argentina (Coskuner and Karababa, 2007). The hypothesis of its Mediterranean origin is corroborated by the discovery of desiccated coriander fruits at archaeological sites within the region (Arora *et al.*, 2021).

Coriander exhibits significant variety, which enables its classification into various groups (Diederichsen, 1996). The essential oil concentration in dried seeds ranges from 0.1 to 1% (Arora *et al.*, 2021; Sharmeen *et al.*, 2021; Shivanand, 2010), imparting a pleasant aroma and flavor to the fragrant fruits of coriander (Banerjee, 2020). The essential oil of coriander includes a number of essential elements, including camphor, limonene, geranial, linalool, linalyl acetate,  $\gamma$ -terpinene, and geranyl acetate (Shivanand, 2010; Sharmeen *et al.*, 2021). Coriander is well-suited to warm climates and can be cultivated in various soil types, although it achieves optimal performance in fertile, well-drained soil (Kassu *et al.*, 2018).

Coriander, beyond its culinary uses, has a well-documented history as a medicinal plant. Traditionally, it has been utilized for its antifungal (Basilico and Basilico, 1999), antioxidant (Chithra and Leelamma, 1999), hypolipidemic, antimicrobial (Silva and Domingues, 2015; Sourmahi *et al.*, 2015), hypocholesterolemia, and anticonvulsant properties (Raza and Choudhary, 2000). In traditional medicine, coriander leaves and fruits are applied in the treatment of skin diseases, with a paste made by mixing them in water applied to the face and forehead. Furthermore, coriander functions as a carminative, stimulating diuretic, tonic, and stomachic agent, contributing to the alleviation of bad breath and oral diseases (Aissaoui *et al.*, 2008).

Coriander cultivation is feasible throughout the year; however, the crop exhibits particular sensitivity to arid and warm climates. Although the primary objective is leaf production, there is also a pursuit of enhanced grain yields. For optimal grain production, coriander should be cultivated in dry and cold conditions, avoiding frost, especially during the flowering and fruit-setting stages. In India, coriander is cultivated with a yield of 1257 kg/ha, a production of 832 tonnes, and an area of 662 ha. Based on production and productivity, Madhya Pradesh ranks first, followed by Gujarat, Rajasthan, and Assam. In Bihar, coriander is cultivated over a 2.2-ha area, with a production of 2.4 tonnes and a 0.26% share in national productivity.

As yield is a quantitative characteristic with complicated inheritance and environmental changes, it must be enhanced indirectly by selecting highly heritable features (Thakur and Saini, 1995). Deb and Khaleque (2009) asserted that understanding the association and interaction of various traits with yield significantly aids breeders in selection work with greater precision and accuracy. The genotypic and phenotypic coefficients of correlation were used to determine the strength and

direction of the relationship between various features and yield (Mode and Robinson, 1959). Path analysis is used to accurately illustrate the relative significance of component character direct and indirect effects on seed production (Bhatt, 1973).

Correlation and path analysis have been employed in breeding studies of various aromatic plants (Gurubuz, 2001). Consequently, path analysis and correlation studies provide comprehensive information to identify key characters to be considered in improvement programs through selection. The present research was undertaken to investigate the relative importance of indirect and direct influences of component traits on seed production and to identify the critical traits to be considered in coriander improvement programs.

## Materials and Methods

The experiments were conducted during the *Rabi* season of 2022-23 at Tirhut College of Agriculture, Dholi, Muzaffarpur. The permanent experimental area (PEA) of Muraul at the College of Agriculture, Dholi, Muzaffarpur, is located on the right bank of the Burhi Gandak River in Agro-Climatic Zone-I in Bihar. It is situated at 25.41° N latitude, 84.6° E longitude, and an altitude of 52.8 meters above mean sea level. The experimental material comprised thirty genotypes: RD-154, RD-366, RD-373, RD-378, RD-379, RD-380, RD-382, RD-388, RD-391, RD-394, RD-395, RD-397, RD-400, RD-408, RD-409, RD-412, RD-413, RD-416, RD-417, RD-418, RD-419, RD-420, RD-422, RD-423, RD-424, RD-425, RD-426, RD-435, RD-437, and R. Dhania-1 (check), collected from various districts of Bihar. The experiment was arranged in a randomized block design with three replications. The recommended doses of manure and fertilizer were applied during field preparation. Row-to-row and plant-to-plant spacing were maintained at 30 cm and 20 cm, respectively. All agronomic practices were adapted to cultivate a healthy crop. In each replication, five randomly selected plants were marked for observation. Observations were recorded for thirteen characters, including plant height (cm), number of primary branches per plant, days to 50% flowering, number of secondary branches per plant, days to maturity, number of umbels per plant, number of seeds per umbellet, number of umbellets per umbel, grain yield per plant (g), 1000-grain weight (g), harvest index (%), and biological yield (%).

## Statistical Analysis

The analysis of variance for testing the variation among treatments was conducted according to the method suggested by Panse and Sukhatme (1989). The

Table 1: The genotypic and phenotypic (in parenthesis) correlation coefficient among 13 quantitative traits in coriander.

Ch.		PH	NPB	NSB	D50%F	DM	NUIP	NUbltsU	NGUblts	NGUel	1000GW	BYP	HI	GYP
PH	rp	1	0.3424**	0.1428	0.3524**	0.2168*	0.2601*	0.3145**	0.3545**	0.1335	-0.1096	0.2194*	-0.1623	0.1239
	rg	1	0.8062**	0.2136	0.4917**	0.3026	0.5257**	0.5645**	0.5704**	0.0954	-0.1776	0.3332	-0.2005	0.2576
NPB	rp		1	0.2915**	0.3472**	0.2523*	0.4253**	0.2716**	0.4286**	-0.1476	0.0366	0.4343**	-0.2362*	0.2916**
	rg		1	0.8205**	0.5863**	0.6276**	0.826**	0.87**	0.7209**	-0.2389	0.1148	0.9047**	-0.3459	0.8028**
NSB	rp			1	0.1759	0.2816**	0.3467**	0.3756**	0.4481**	-0.3088**	-0.295**	0.4806**	-0.022	0.4472**
	rg			1	0.2363	0.463**	0.5061**	0.5634**	0.6025**	-0.4556*	-0.3366	0.71**	-0.0862	0.6846**
D50%F	rp				1	0.3378**	0.2732**	0.5302**	0.2939**	-0.0947	0.0094	0.491**	-0.1644	0.3775**
	rg				1	0.4074*	0.313	0.6457**	0.3536	-0.0815	-0.0349	0.5768**	-0.2715	0.4771**
DM	rp					1	0.3961**	0.4585**	0.3091**	-0.2854**	-0.1503	0.5164**	-0.2392*	0.3735**
	rg					1	0.5875**	0.5365**	0.456*	-0.3823*	-0.219	0.6775**	-0.4535*	0.5281**
NUIP	rp						1	0.3379**	0.4398**	-0.1218	0.0077	0.4655**	-0.158	0.3704**
	rg						1	0.5324**	0.5448**	-0.1077	0.0034	0.6323**	-0.3517	0.5155**
NUbltsU	rp							1	0.5157**	0.0296	0.0013	0.67**	-0.1433	0.5656**
	rg							1	0.7761**	0.0027	-0.0197	0.9209**	-0.2564	0.8331**
NGUblts	rp								1	-0.0967	-0.0328	0.6044**	-0.0604	0.5397**
	rg								1	-0.1408	0.0369	0.7925**	-0.168	0.7425**
NGUel	rp									1	0.1146	-0.1772	0.0472	-0.1435
	rg									1	0.1908	-0.2281	-0.037	-0.2459
1000GW	rp										1	-0.0347	-0.1146	-0.0961
	rg										1	-0.0277	-0.207	-0.1036
BYP	rp											1	-0.1802	0.8645**
	rg											1	-0.19	0.9413**
HI	rp												1	0.335**
	rg												1	0.1532
GYP	rp													1
	rg													1

\*, \*\*Significant at 5 and 1 % levels, rg= genotypic correlation; rp = phenotypic correlation; Ch.: Characters;

phenotypic and genotypic correlation coefficients were calculated as per the methods outlined by Al-Jibouri *et al.*, (1958). Path analysis based on genotypic correlations was performed following the approach of Dewey and Lu (1959).

## Results and Discussion

The analysis of variance showed significant differences among genotypes for all traits examined, indicating substantial variability within the materials. Crop yield results from the interaction of numerous interrelated characteristics. Consequently, by correlating their relationship to seed production per plot, selection need to be predicated on these constituent characteristics. Character association elucidated the mutual relationship between two traits, serving as a crucial parameter for determining the appropriate selection strategy for crop improvement. The genotypic and phenotypic correlations among yield and yield components in coriander are presented in Table 1. The significant correlation of traits suggests considerable potential for both direct and indirect selection to enhance crop performance. Generally, the estimates of the genotypic correlation coefficient were higher than the corresponding phenotypic ones, demonstrating a robust innate correlation between the characteristics examined.

The experiment showed a strong positive association between grain production per plant and a number of variables, including the number of primary branches per plant, days to 50 percent flowering, number of secondary branches, number of umbellets per umbel, days to maturity,

the number of umbels per plant, the number of grains per umbellet, biological yield per plant, and harvest index. These result simply that choosing for any of these traits could lead to simultaneous improvements in other traits, ultimately enhancing grain yield in coriander. These outcomes align with the conclusions of Moharana *et al.*, (2023), Pooja *et al.*, (2023), Sandhu *et al.*, (2018), Meena *et al.*, (2014), Singh *et al.*, (2013), Kassahun *et al.*, (2013), and Meena *et al.*, (2010).

Plant height exhibited a significant positive correlation with the number of umbellets per umbel (0.3145\*\*), number of primary branches per plant (0.3424\*\*), number of grains per umbellet (0.3545\*\*) and days to 50 percent flowering (0.3524\*\*). These outcomes align with those of Bhandari and Gupta (1993). The number of secondary branches per plant showed a significant positive correlation with days to maturity (0.2816\*\*), the number of umbellets per umbel (0.3756\*\*), the number of umbels per plant (0.3467), number of grains per umbellet (0.4481\*\*), and biological yield (0.4806\*\*). Days to 50 percent flowering exhibited a significant positive correlation with days to maturity (0.3378\*\*), number of umbels per plant (0.2732\*\*), number of umbellets per umbel (0.5302\*\*), number of grains per umbellet (0.2939\*\*) and biological yield per plant (0.491\*\*). Days to maturity exhibited a significant positive correlation with the number of umbels per plant (0.3961\*\*), the number of umbellets per umbel (0.4585\*\*), the number of grains per umbellet (0.3091\*\*), and biological yield (0.5164\*\*). The number of umbels per plant showed a significant

**Table 2:** Direct (diagonal) and indirect effect of different traits contributing to yield in coriander.

Ch.	PH	NPB	NSB	D50%F	DM	NUIP	NUbltsP	NGUblts	NGUel	1000GW	BYP	HI	GYP
PH	<b>-0.00019</b>	-0.00069	-0.00043	-0.00425	-0.00006	0.00302	0.0004	-0.00462	0.00031	0.00062	0.21207	-0.08228	0.1239
NPB	-0.00007	<b>-0.00201</b>	-0.00087	-0.00419	-0.00007	0.00494	0.00034	-0.00558	-0.00034	-0.00021	0.41978	-0.11984	0.29188
NSB	-0.00003	-0.00059	<b>-0.00299</b>	-0.00212	-0.00008	0.00403	0.00048	-0.00583	-0.00071	0.00166	0.46444	-0.01115	0.44711
D50%F	-0.00007	-0.0007	-0.00053	<b>-0.01206</b>	-0.00009	0.00317	0.00067	-0.00383	-0.00022	-0.00005	0.47459	-0.08339	0.37749
DM	-0.00004	-0.00051	-0.00084	-0.00407	<b>-0.00027</b>	0.0046	0.00058	-0.00402	-0.00066	0.00084	0.49904	-0.12126	0.37339
NUIP	-0.00005	-0.00086	-0.00104	-0.00329	-0.00011	<b>0.01162</b>	0.00043	-0.00573	-0.00028	-0.00004	0.44994	-0.08010	0.37049
NUbltsU	-0.00006	-0.00055	-0.00112	-0.00639	-0.00012	0.00393	<b>0.00127</b>	-0.00671	0.00007	-0.00001	0.6478	-0.07269	0.56542
NGUblts	-0.00007	-0.00086	-0.00134	-0.00355	-0.00008	0.00511	0.00065	<b>-0.01302</b>	-0.00022	0.00019	0.58391	-0.03072	0.54
NGUel	-0.00003	0.00030	0.00092	0.00114	0.00008	-0.0014	0.00004	0.00126	<b>0.0023</b>	-0.00064	-0.17128	0.02393	-0.1434
1000GW	0.00002	-0.00007	0.00088	-0.00011	0.00004	0.00009	0	0.00043	0.00026	<b>-0.00561</b>	-0.03364	-0.05809	-0.0958
BYP	-0.00004	-0.00087	-0.00144	-0.00592	-0.00014	0.00541	0.00085	-0.00786	-0.00041	0.0002	<b>0.96638</b>	-0.09135	0.86481
HI	0.00003	0.00048	0.00007	0.00198	0.00006	-0.0018	-0.0002	0.00079	0.00011	0.00064	-0.17418	<b>0.50693</b>	0.33489

Ch.: Characters; PH=Plant height (cm), NPB=Number of primary branches per plant, NSB=Number of secondary branches per plant, D50%F= Days to 50 percent flowering, DM= Days to maturity, NUIP=Number of umbels per plant, NUbltsU=Number of umbellets per umbel, NGUblts=Number of grains per umbel, 1000 G W = 1000 grain weight (g), BYP = Biological yield, HI= Harvest index (%), GYP= Grain yield per plant (g)

positive correlation with the number of umbellets per umbel (0.3379\*\*), the number of grains per umbellet (0.4398\*\*), and biological yield (0.4655\*\*). Similar findings were also reported by Meena *et al.*, (2010), Singh *et al.*, (2006), Agrihotri *et al.*, (1997), and Vedamuthu *et al.*, (1989). The number of umbellets per umbel exhibited a significant positive correlation with the number of grains per umbellet (0.1557\*\*) and biological yield (0.67\*\*). The number of grains per umbellet showed a significant positive correlation only with biological yield (0.6044\*\*), as also reported by Sanjeev *et al.*, (1990).

Yield is the cumulative result of different component characteristics that contribute to it either directly or indirectly. Correlation studies provide perspective into the mutual associations among these traits. In contrast, path coefficient analysis elucidates the magnitude of both indirect and direct contributions of each trait to dependent variables such as seed yield. By partitioning the correlation coefficient into indirect and direct effects, one can discern the nature and magnitude of the influence of other traits on seed yield.

The positive or negative associations characteristics of the yield component facilitate the selection of crop species traits for targeted genetic enhancement during breeding programs. A balanced consideration of both positive and negative contributions can establish a clear relationship between a specific trait and grain yield per plant. Consequently, path coefficient analysis serves as a valuable tool in selection processes within crop improvement programs focused on breeding. Path analysis results are especially helpful for features controlled by additive gene activity.

The results of the current investigation on path coefficient analysis, as presented in Table 2, demonstrate that biological yield, followed by number of grains per umbel, number of umbels per plant, number of umbellets

per umbel, and harvest index exhibit positive direct effects on grain yield per plant. Consequently, choosing for these characteristics is recommended for yield enhancement. Similar studies conducted by Pooja *et al.*, (2023), Kumawat *et al.*, (2022), Kumar *et al.*, (2022), Choudhary *et al.*, (2021), Meena *et al.*, (2014), Kassahun *et al.*, (2013), Palanikumar *et al.*, (2012), and Singh *et al.*, (2006) corroborate these findings.

## Conclusion

The present study revealed substantial genetic variability among coriander genotypes for all the traits studied, indicating ample scope for selection and genetic improvement. Grain yield per plant exhibited significant and positive associations with several yield-attributing traits, and the generally higher genotypic correlations than phenotypic correlations suggested strong inherent genetic relationships with minimal environmental influence. Path coefficient analysis further indicated that biological yield had the highest positive direct effect on grain yield per plant, followed by harvest index, number of umbels per plant, number of grains per umbel, and number of umbellets per umbel. These traits also contributed indirectly through favorable interrelationships with other characters. Therefore, simultaneous selection for these key traits would be effective in enhancing grain yield in coriander. Overall, the combined use of correlation and path coefficient analyses provides a reliable basis for formulating efficient selection criteria aimed at developing high-yielding coriander genotypes.

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