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GENETIC VARIABILITY, CORRELATION AND PATH COEFFICIENT ANALYSIS IN CARROT (*Daucus carota* L.) UNDER SEMI-ARID REGION OF RAJASTHAN INDIA

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ABSTRACT

The present investigation was conducted at the Agricultural Research Farm, Suresh Gyan Vihar University, Jaipur to study the Genetic Variability, Correlation and Path Coefficient Analysis in Carrot (*Daucus carota* L.) under Semi-Arid Region of Rajasthan.

The experiment was conducted during Rabi season, 2025-26. The experiment was laid out in randomized block design with eighteen treatments including Pusa Kesar (T₁), Pusa Narayan Jyoti (T₂), Pusa Yamdagini (T₃), VRCAR-81 (T₄), VRCAR-85 (T₅), VRCAR-124 (T₆), Hisar Gairic (T₇), HL-1 (T₈), HL-2 (T₉), RL-1 (T₁₀), RL-2 (T₁₁), RL-3 (T₁₂), ML-1 (T₁₃), ML-2 (T₁₄), ML-3 (T₁₅), PL-1 (T₁₆), PL-2 (T₁₇), and PL-3 (T₁₈) replicated thrice. The observed data was analyzed in OPSTAT. The results revealed that the genotypes Hisar Gairic, HL-1 and RL-1 & 2 were the best with respect to highest total yield per hectare. Further, Hisar Gairic, ML-2, PL-1 and Pusa Narayan Jyoti was also a promising genotype in terms of plant height, root length. The genotype Hisar Gairic & 2, RL-1 & 2 and ML-2 were promising for fresh root weight per plant. Maximum GCV, PCV heritability, genetic advance was observed in carotene content. Fresh weight of root, yield per plot, number of leaves, leaf length, root length was positively correlated with total yield of carrot. Path coefficient analysis confirmed that fresh root weight, number of leaves and root shoot ratio exerts the higher direct positive effect on carrot yield.

From this experiment it may be concluded that Hisar Gairic, HL-1 and RL-1 & 2 genotypes may be chosen for suitable parent for hybridisation and also commercial cultivation. Fresh root weight, number of leaves, leaf length, root length and root shoot ratio may be the most important characters for hybridisation of carrot for improving yield.

Key words: Carrot, correlation, genotype, path analysis, variability

Introduction

Carrot is an important cool-season vegetable crop belonging to the family Apiaceae and is cultivated widely across temperate, subtropical and tropical regions of the world. Globally, carrot and turnip are cultivated over an area of about 1.15 million hectares with a production of nearly 45 million tonnes, with China, Uzbekistan, Russia, the USA and Ukraine being the major producers (FAO,

2024; Statista, 2025). In India, carrot is cultivated on 0.11 million hectares with an annual production of around 2.2 million tonnes and an average productivity of about 20 t ha⁻¹. States such as Uttar Pradesh, (NHB, 2024) Haryana, Punjab, Karnataka and Andhra Pradesh, (DAC & FW, 2024) Maharashtra and Rajasthan (Meena *et al.*, 2023) are major contributors to carrot production. Increasing demand for fresh carrots as well as processed

products like juice, dehydrated flakes and baby carrots has enhanced its commercial importance in recent years (FAOSTAT, 2024; GOI, 2024). Rajasthan occupies a significant position in carrot cultivation in the north-western dryland belt owing to its suitable sandy loam soils, cool winter climate and availability of irrigation facilities in canal-command and well-irrigated areas. Districts such as Jaipur, Sikar, Alwar, Bharatpur, Nagaur and Sri Ganganagar are important carrot-growing pockets of the state. As per recent horticultural estimates, Carrot is cultivated in Rajasthan on about 13 thousand hectares with an annual production of approximately 360 thousand tonnes, with an average productivity of around 24 t ha⁻¹. (NHB, 2024; GOI, 2024; Directorate of Horticulture, Rajasthan, 2024).

Rajasthan represents a unique agro-ecological region characterized by semi-arid climate, erratic rainfall, high temperature fluctuations and low soil fertility. Vegetable cultivation under such conditions faces challenges related to moisture stress, nutrient imbalance and reduced productivity. Despite these constraints, carrot cultivation is expanding in irrigated and partially irrigated areas of Rajasthan due to its short duration, high market value and adaptability to diverse soil types (Yadav *et al.*, 2021; Meena *et al.*, 2023). Genetic variability studies provide vital information regarding the extent of variation present in a population and help breeders to identify superior genotypes. Parameters such as genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance are important tools for assessing the effectiveness of selection. High heritability coupled with high genetic advance indicates additive gene action and greater scope for improvement through selection (Singh and Chaudhary, 2018). Correlation analysis helps in understanding the degree and direction of association between yield and its contributing traits. Positive and significant correlation of yield with component characters suggests that improvement in these traits would result in simultaneous improvement in yield. However, correlation alone does not provide information on the direct and indirect influence of individual traits on yield, which may sometimes lead to misleading conclusions (Dewey and Lu, 1959; Kumar *et al.*, 2021). Path coefficient analysis partitions correlation coefficients into direct and indirect effects, thereby providing a clear picture of cause-and-effect relationships among traits. This technique enables identification of characters having the maximum direct contribution towards yield and helps breeders to formulate effective selection indices. In carrot breeding programmes, path analysis has been found useful in identifying key yield-

Table 1: Mean sum of square of different traits.

Characters	Mean Sum of Square		
	Replication	Treatment	Error
DF	2	17	34
Plant height at 30 DAS	0.64	30.38**	3.27
Plant height at 60 DAS	0.14	28.76**	2.64
Number of leaves per plant	0.01	18.54**	0.34
Leaf length	0.05	77.38**	5.56
Root length	0.00	117.21**	3.21
Root diameter	0.00	1.56**	0.06
Fresh root weight per plant	8.53	1587.79**	26.03
Root yield per plot	0.14	14.54**	0.43
Root:shoot ratio	0.00	0.66**	0.02
Yield (q/ha)	0.42	143.31**	2.79
TSS	0.02	3.78**	0.20
Total sugar	0.01	0.46**	0.05
Carotene content	0.00	9.21**	0.05
**1% level of significance			

determining traits such as root weight, root length and root diameter (Wright, 1921; Singh *et al.*, 2019).

Therefore, considering the above facts and research gaps, the present investigation entitled “Genetic Variability, Correlation and Path Coefficient Analysis in Carrot (*Daucus carota* L.) under Semi-Arid Region of Rajasthan” has been planned to identify superior genotypes and key yield-contributing traits for effective selection and genetic improvement.

Materials and Methods

The present investigation was conducted on the Agricultural Research Farm, Department of Horticulture, School of Agriculture at Suresh Gyan Vihar University, Jaipur (Rajasthan) during 2025-26. The experiment was laid out in Randomized Block Design (FRBD) having eighteen treatments (genotypes) with 3 replications. Seeds were sown at a spacing of 30 cm × 10 cm in a plot having dimension of 2.4 m × 1.2 m (2.88 m²) accommodating 96 plants per plot. Eighteen genotypes used in the present study viz. Pusa Kesar (T₁), Pusa Narayan Jyoti (T₂), Pusa Yamdagini (T₃), VRCAR-81 (T₄), VRCAR-85 (T₅), VRCAR-124 (T₆), Hisar Gairic (T₇), HL-1 (Haryana Local) (T₈), HL-2 (T₉), RL-1 (Rajasthan Local) (T₁₀), RL-2 (T₁₁), RL-3 (T₁₂), ML-1 (Madhya Pradesh Local) (T₁₃), ML-2 (T₁₄), ML-3 (T₁₅), PL-1 (Punjab Local) (T₁₆), PL-2 (T₁₇) and PL-3 (T₁₈). The observed data was analysed through OPSTAT, TNAUSTAT and DOSBOX. The total soluble solids (TSS) content of roots was estimated using an ERMA hand refractometer (range: 0-32°Brix). Total sugar content of roots was determined by the Anthrone method. The extraction and

Table 2: Mean performance and estimation of phenotypic and genotypic coefficients of variability (PCV and GCV), heritability and genetic advance (G A) as percentage of mean for various character.

Genotype /Character	PH 30	PH 60	NL	LL	RL	RD	FRW	RYP	R:S	TSS	TS	CC	TY
T ₁	24.50	32.10	7.20	38.40	16.50	4.10	78.30	7.52	1.80	8.50	3.50	5.20	23.49
T ₂	26.10	35.80	6.80	41.20	17.20	4.30	82.10	7.88	1.95	9.00	3.80	6.10	24.63
T ₃	29.24	34.50	6.32	39.50	18.10	4.93	86.42	8.30	2.10	9.50	4.10	4.80	25.93
T ₄	22.80	30.50	5.90	36.00	15.80	3.85	72.40	6.95	1.65	8.20	3.20	3.90	21.72
T ₅	23.40	31.90	6.15	37.20	16.20	3.95	75.90	7.29	1.72	8.40	3.40	4.20	22.77
T ₆	25.00	33.40	6.50	40.10	16.90	4.20	80.50	7.73	1.88	8.80	3.60	5.52	24.15
T ₇	24.20	35.40	11.02	46.00	30.66	3.31	135.00	12.96	1.40	9.20	3.30	2.98	40.50
T ₈	22.00	29.80	6.94	48.00	29.67	3.44	118.00	11.33	2.43	10.10	3.60	1.76	35.40
T ₉	24.00	27.60	10.01	46.68	27.00	3.90	80.00	7.68	1.93	7.40	4.10	1.37	24.00
T ₁₀	14.20	30.60	10.02	38.34	29.00	4.50	115.00	11.04	1.92	6.10	4.20	1.01	34.50
T ₁₁	25.20	28.80	9.01	40.68	29.67	4.07	115.00	11.04	2.79	8.00	2.90	3.30	34.50
T ₁₂	21.40	31.20	10.02	34.67	29.67	2.64	40.00	3.84	2.18	7.00	3.80	3.35	12.00
T ₁₃	20.40	28.60	13.01	41.31	29.00	2.10	100.00	9.60	2.50	6.90	3.30	1.71	30.00
T ₁₄	22.60	36.80	12.01	51.68	30.67	3.60	115.00	11.04	1.29	8.60	3.20	2.63	34.50
T ₁₅	24.20	32.59	9.02	52.00	28.00	2.67	74.13	7.12	1.72	7.40	3.60	1.07	22.24
T ₁₆	27.80	30.20	12.01	44.34	31.67	3.63	80.00	7.68	1.78	9.20	2.80	0.68	24.00
T ₁₇	22.00	25.80	7.01	38.34	28.67	3.30	101.33	9.73	3.08	8.00	3.20	1.75	30.40
T ₁₈	24.07	27.26	13.03	42.51	20.00	2.93	110.20	10.44	1.53	6.20	3.60	0.70	33.27
Grand Mean	23.51	31.27	9.00	42.05	24.69	3.63	92.18	8.84	1.98	8.14	3.51	2.89	27.67
C.D.(5%)	3.011	2.705	0.97	3.928	2.984	0.416	8.501	1.095	0.22	0.753	0.363	0.386	2.785
CV(%)	7.69	5.19	6.47	5.60	7.25	6.87	5.53	7.43	6.66	5.55	6.20	8.01	6.04
PCV(%)	14.92	10.77	28.13	12.92	26.00	20.62	25.36	25.63	24.29	14.52	12.31	60.96	25.46
GCV(%)	12.79	9.44	27.37	11.64	24.97	19.44	24.75	24.53	23.36	13.41	10.63	60.43	24.74
H ² (%)	73.47	76.77	94.71	81.17	92.22	88.90	95.24	91.59	92.48	85.37	74.62	98.27	94.37
GAM(%)	22.59	17.04	54.88	21.60	49.40	37.76	49.76	48.36	46.28	25.53	18.92	123.40	49.50
PV	12.31	11.35	6.41	29.50	41.21	0.56	546.61	5.14	0.23	1.40	0.19	3.10	49.63
GV	9.04	8.71	6.07	23.94	38.00	0.50	520.59	4.71	0.21	1.19	0.14	3.05	46.84
EV	3.27	2.64	0.34	5.55	3.21	0.06	26.03	0.43	0.02	0.20	0.05	0.05	2.79
PH30: plant height (cm) at 30 DAS; PH60: plant height at 60 DAS, NL: number of leaves, LL: leaf length (cm); RL: root length (cm); RD: root diameter (cm); FRW: fresh weight of roots (g); RYP: root yield per plant (kg); R: S: root shoot ratio; TSS: total soluble solid; TS: total sugar (%); CC: carotene content (mg/100g); TY: total yield (q/ha)													

quantification of total carotenoids were performed according to the method described by Thimmiah (1999).

Results and Discussion

Variability studies

Based on the mean values with respect to characters, the genotypes Hisar Gairic, HL-1 and RL-1 & 2 were the best with respect to highest total yield per hectare. Further, Hisar Gairic, ML-2, PL-1 and Pusa Narayan Jyoti was also a promising genotype in terms of plant height, root length. The genotype Hisar Gairic & 2, RL-1 & 2 and ML-2 were promising for fresh root weight per plant (Table 2). These genotypes can be used as potent parents in an appropriate breeding programme for improving total yield per hectare and their components. Analysis of variance revealed that the mean square due to genotypes was significant for all the evaluated traits,

suggesting that the experimental material possessed considerable genetic variability (Table 1). Similar findings of significant differences in mean squares due to genotypes have been reported previously by Gupta *et al.*, (2012), Jain *et al.*, (2010), and Dod *et al.*, (2013) in carrot, Makhdoomi *et al.*, (2007), Mapari *et al.*, (2009) in radish, as well as Sharma *et al.*, (2015) in beetroot. In general, the phenotypic coefficient of variation (PCV) was greater than the corresponding genotypic coefficient of variation (GCV) for all characters, indicating the relative importance of the environment in the expressions of these characters. These results are in close accordance with the findings of Yadav *et al.*, (2009) and Jain *et al.*, (2010). However, the narrow difference observed between the GCV and PCV across all traits indicates that these characters were less affected by environmental influences, implying high genetic control. High GCV

Table 3: Estimation of genotypic and phenotypic correlation coefficient of different traits in radish.

Traits	PH 30	PH 60	NL	LL	RL	RD	FRW	RYP	R:S	TSS	TS	CC	TY
PH 30	1	0.215	-0.196	0.121	-0.288*	0.214	-0.196	-0.176	-0.12	0.523**	-0.182	0.360**	-0.198
PH 60	0.313*	1	-0.074	0.340*	-0.098	0.396**	0.059	0.06	-0.444**	0.535**	0.226	0.559**	0.064
NL	-0.213	-0.205	1	0.424**	0.632**	-0.490**	0.333*	0.333*	-0.182	-0.396**	-0.117	-0.631**	0.340*
LL	0.17	0.173	0.374**	1	0.509**	-0.123	0.433**	0.439**	-0.219	0.288*	0.019	-0.371**	0.437**
RL	-0.345*	-0.273*	0.611**	0.449**	1	-0.376**	0.396**	0.401**	0.284*	-0.059	-0.146	-0.659**	0.397**
RD	0.261	0.289*	-0.612**	-0.312*	-0.517**	1	0.084	0.093	-0.036	0.437**	0.346*	0.524**	0.085
FRW	-0.226	-0.045	0.309*	0.396**	0.365**	0.019	1	0.984**	0.059	0.149	-0.12	-0.294*	0.995**
RYP	-0.24	-0.039	0.300*	0.393**	0.367**	0.019	1.009**	1	0.056	0.157	-0.134	-0.285*	0.978**
R:S	-0.117	-0.669**	-0.251	-0.370**	0.236	-0.127	0.015	0.022	1	0.024	-0.014	-0.05	0.069
TSS	0.650**	0.447**	-0.521**	0.16	-0.178	0.363**	0.077	0.083	-0.06	1	-0.136	0.463**	0.141
TS	-0.278*	0.05	-0.228	-0.17	-0.300*	0.270*	-0.233	-0.228	-0.154	-0.328*	1	0.131	-0.104
CC	0.402**	0.581**	-0.677**	-0.469**	-0.726**	0.520**	-0.328*	-0.328*	-0.079	0.457**	0.096	1	-0.295*
TY	-0.224	-0.052	0.309*	0.392**	0.361**	0.015 ^{NS}	1.003**	1.011**	0.007	0.076	-0.242	-0.331*	1

Upper diagonal: phenotypic correlation coefficient; Lower diagonal: genotypic correlation coefficient;
 PH30: plant height (cm) at 30 DAS; PH60: plant height at 60 DAS, NL: number of leaves, LL: leaf length (cm);
 RL: root length (cm); RD: root diameter (cm); FRW: fresh weight of roots (g); RYP: root yield per plant (kg);
 R:S: root shoot ratio; TSS: total soluble solid; TS: total sugar (%); CC: carotene content (mg/100g);
 TY: total yield (q/ha), *1% level of significance, **5% level of significance

estimates were recorded for carotene content (60.43), number of leaves (27.37), root length (24.97) denoting wide range of genetic variation for these characters. High GCV estimates for total yield per hectare and average weight of root were also observed by Yadav *et al.*, (2009), Jain *et al.*, (2010), Dod *et al.*, (2013) and Amin and Single (2010) in carrot and for root weight and total yield by Ullah *et al.*, (2010) in radish and carotene content by Priya and Santhi (2015) in carrot. Burton (1952) suggested that GCV along with heritability gives a better idea about the efficiency of selection. In the present study high heritability was recorded for carotene content, fresh weight of roots and number of leaves plant. In the present study, high heritability along with high GCV was recorded for carotene content (98.27), fresh weight of roots (95.24), number of leaves per plant (94.71) suggesting that these four traits can be improved by selection. High heritability was reported in carrot for fresh weight/plant and total yield by Amin and Single (2010), for fresh weight per plant, root weight and root yield (q/ha) by Jain *et al.*, (2010) and for fresh weight per five plant, root weight per five plants Gupta *et al.*, (2012), for TSS by Yadav *et al.*, (2009), for root carotene, and root weight by Priya and Santhi (2015), for TSS and carotene content by Kaur *et al.*, (2009) in carrot, for root yield by Ullah *et al.*, (2010) and total plant weight, root weight and TSS by Singh *et al.*, (2025), Tare *et al.*, (2026) in radish. Traits like total yield (123.40%), number of leaves (54.88%) and fresh root weight (49.76%) show exceptionally high heritability paired with high genetic advance. This indicated that these traits are predominantly controlled by additive gene action, making simple phenotypic

selection highly effective for future generation improvements. Further, these characters also had high genetic gain indicating that most likely the heritability for these traits was due to additive gene effect and selection would be effective. Priya and Santhi (2015) also reported importance of high heritability along with high genetic advance in predicting the gain under phenotypic selection than heritability alone.

Correlation analysis

Yield is a complex character and it depends upon number of characters, therefore, yield can be improved by direct as well as indirect selection. To identify component characters, correlation is an important tool. Further, estimate of correlation at genotypic as well as phenotypic level is more informative. In the present study, the trend of genotypic and phenotypic correlation was almost similar for all the characters. The estimates of genotypic correlation coefficient (rg) were slightly higher than their corresponding phenotypic correlation coefficient (rp) for all the characters (Table 3). Higher value of genotypic correlation may be due to masking effect of environment on the genotype leading to reduced phenotypic expression (Table 3). Genotypic correlation coefficient was higher than corresponding phenotypic correlation coefficient for most of the characters similar result have also been reported by Singh *et al.*, (2005), Yadav *et al.*, (2009) and Gupta *et al.*, (2012) in carrot and Rajput and Pal (2014), Singh *et al.*, (2025), Tare *et al.*, (2026) in radish.

Total yield per hectare exhibited significant and positive correlation both at genotypic and phenotypic levels

Table 4: Estimation of Path using genotypic correlations in radish.

Traits		PH 30	PH 60	NL	LL	RL	RD	FRW	RYP	R:S	TSS	TS	CC
PH 30	G	-0.11825	0.01735	-0.03692	0.0117	0.05293	0.01702	-0.20078	-0.00884	-0.01524	0.07131	0.00381	-0.01849
	P	0.00244	0.01073	-0.0043	0.00089	0.01292	0.00168	-0.1932	-0.00003	-0.006	-0.0082	0.00004	-0.0148
PH 60	G	-0.03696	0.05552	-0.03564	0.01193	0.04181	0.01884	-0.03994	-0.00142	-0.08732	0.04908	-0.00069	-0.02675
	P	0.00052	0.04994	-0.0016	0.00252	0.0044	0.00311	0.05853	0.00001	-0.0221	-0.0084	-0.00005	-0.023
NL	G	0.02516	-0.0114	0.17352	0.02575	-0.09355	-0.03985	0.2737	0.01103	-0.03283	-0.05721	0.00314	0.03117
	P	-0.0005	-0.0037	0.02196	0.00314	-0.0283	-0.0039	0.32805	0.00006	-0.0091	0.0062	0.00002	0.02598
LL	G	-0.02012	0.00963	0.06494	0.06879	-0.06877	-0.02034	0.35061	0.01444	-0.04829	0.01761	0.00234	0.02159
	P	0.00029	0.01699	0.00931	0.00741	-0.0228	-0.001	0.42653	0.00008	-0.0109	-0.0045	0	0.01528
RL	G	0.04085	-0.01515	0.10597	0.03088	-0.15319	-0.03366	0.32312	0.01349	0.03076	-0.01958	0.00412	0.03341
	P	-0.0007	-0.0049	0.01388	0.00377	-0.0448	-0.003	0.39032	0.00007	0.01417	0.00092	0.00003	0.02713
RD	G	-0.03089	0.01606	-0.10616	-0.02149	0.07917	0.06514	0.01657	0.00071	-0.01656	0.03982	-0.00371	-0.02391
	P	0.00052	0.01978	-0.0108	-0.0009	0.01684	0.00786	0.08244	0.00002	-0.0018	-0.0068	-0.00007	-0.0216
FRW	G	0.02678	-0.0025	0.05357	0.02721	-0.05584	0.00122	0.88646	0.03707	0.00195	0.00845	0.00321	0.01511
	P	-0.0005	0.00296	0.0073	0.00321	-0.0178	0.00066	0.98601	0.00018	0.00296	-0.0023	0.00002	0.01211
RYP	G	0.02843	-0.00215	0.05208	0.02702	-0.05624	0.00125	0.89404	0.03676	0.0029	0.00909	0.00313	0.01507
	P	-0.0004	0.00302	0.00731	0.00325	-0.018	0.00073	0.97008	0.00018	0.00279	-0.0025	0.00003	0.01174
R:S	G	0.01381	-0.03713	-0.04363	-0.02545	-0.0361	-0.00826	0.01326	0.00082	0.13055	-0.00654	0.00211	0.00364
	P	-0.0003	-0.0222	-0.004	-0.0016	-0.0127	-0.0003	0.05854	0.00001	0.04986	-0.0004	0	0.00205
TSS	G	-0.07683	0.02483	-0.09045	0.01104	0.02733	0.02363	0.06822	0.00305	-0.00778	0.10975	0.0045	-0.02101
	P	0.00128	0.02673	-0.0087	0.00214	0.00263	0.00343	0.14737	0.00003	0.00118	-0.0157	0.00003	-0.0191
TS	G	0.03284	0.00278	-0.03961	-0.01173	0.04598	0.01761	-0.20688	-0.00837	-0.02004	-0.03596	-0.01373	-0.0044
	P	-0.0005	0.0113	-0.0026	0.00014	0.00655	0.00271	-0.118	-0.00002	-0.0007	0.00213	-0.0002	-0.0054
CC	G	-0.04751	0.03227	-0.11754	-0.03228	0.11121	0.03384	-0.29101	-0.01204	-0.01031	0.05012	-0.00131	-0.04602
	P	0.00088	0.02794	-0.0139	-0.0028	0.02956	0.00412	-0.2902	-0.00005	-0.0025	-0.0073	-0.00003	-0.0412
		Residual	-0.0037										

PH30: plant height (cm) at 30 DAS; PH60: plant height at 60 DAS, NL: number of leaves, LL: leaf length (cm);
 RL: root length (cm); RD: root diameter (cm); FRW: fresh weight of roots (g); RYP: root yield per plant (kg);
 R:S: root shoot ratio; TSS: total soluble solid; TS: total sugar (%); CC: carotene content (mg/100g)

with root yield per plot (rg: 1.011, rp:0.978), fresh weight of roots (rg: 1.003, rp:0.995), leaf length (rg: 0.392, rp:0.437) and root length (rg: 0.361, rp:0.397). Similar results exhibiting significant positive association between plant height had been reported by Singh *et al.*, (2005) for fresh root weight per plant by Gupta and Verma (2007) for root to shoot ratio by Yadav *et al.*, (2009), for fresh weight by Gupta *et al.*, (2012) in carrot and for plant height by Ullah *et al.*, (2010), Rajput and Pal (2014), Singh *et al.*, (2025), Tare *et al.*, (2026) in radish and plant height by Palanikumar *et al.*, (2012) in coriander. Negative correlation at genotypic and phenotypic levels of total yield was observed with carotenoid content (rg: -0.331, rp: -0.295) and plant height at 30 DAS (rg:-0.224, rp: -0.198). It was in conformity with the findings of Murali *et al.*, (1998) for number of leaf per plant in radish, Datta *et al.*, (2006) and Awas *et al.*, (2014) for plant height in coriander. Root length was significantly and positively correlated with fresh weight of roots and root yield per plant whereas it was negatively correlated with carotene content and root diameter. Similarly, Singh *et al.*, (2005)

recorded positive and significant correlation of root length with plant height but, observed negative and significant correlation of root length with carotene content. Singh *et al.*, (2005) who observed significant and positive correlation with plant height, root diameter in carrot, for root diameter Sharma *et al.*, (2009), for plant height Rajput and Pal (2014), for root diameter Mallikarjunarao *et al.*, (2015), Singh *et al.*, (2025), Tare *et al.*, (2026) in radish.

Path analysis

The correlation analysis highlighted information which is incomplete in the sense that it does not throw light on the underlying causes that are operative for the various inter relationships (Table 4). The expression of a complex character such as root yield per plant depends upon the interplay of number of component attributes (Kumar *et al.*, 2023; Yogitha *et al.*, 2025). A better picture of the contribution of each component building up the total genetic architecture of a complex character may be obtained through the analysis of causal scheme. Hence, in such situation path coefficient analysis devised by

Wright (1921) had been useful in partitioning direct and indirect effects of association which allow a detailed examination of specific forces acting to produce a given correlation and measures the relative importance of each causal character. Such a study provides a realistic basis for allocation of weightage to each attribute in deciding a suitable criterion for genetic improvement (Habib *et al.*, 2026). The objective of this analysis in the present investigation was to compare the results obtained from simple correlation and path coefficient analysis and to demonstrate the significance of path coefficient analysis in determining the true nature of association between the characters. The genotypic path coefficient analysis revealed that fresh weight of roots exerted the highest positive direct effect (0.88646) on total yield, followed by number of leaves (0.17352), root: shoot ratio (0.13055), total soluble solids (0.10975), leaf length (0.06879), root diameter (0.06514), plant height at 60 DAS (0.05552) and root yield per plant (0.03676). Conversely, the maximum negative direct effect on total yield was manifested by root length (-0.15319), followed by plant height at 30 DAS (-0.11825), carotene content (-0.04602) and total sugar (-0.01373). The phenotypic path coefficient analysis revealed that fresh weight of roots exerted the highest positive direct effect (0.98601) on total yield, followed by plant height at 60 DAS (0.04994), root: shoot ratio (0.04986), number of leaves (0.02196), root diameter (0.00786), leaf length (0.00741), plant height at 30 DAS (0.00244), and root yield per plant (0.00018). Conversely, the maximum negative direct effect on total yield was manifested by root length (-0.04448), followed by carotene content (-0.04120), total soluble solids (-0.01570), and total sugar (-0.00020). Singh *et al.*, (2005) in carrot, Singh *et al.*, (2025), Tare *et al.*, (2026) in radish and Sravanthi *et al.*, (2014) in coriander had observed similar results. This was in confirmation with the finding of Ki *et al.*, (2026) in carrot, Singh and Singh (2012), Esho and Jasim (2022), Huh *et al.*, (2024) in radish and Sravanthi *et al.*, (2014) in coriander.

Conclusion

On the basis of mean performance the genotypes Hisar Gairic, HL-1, ML-2 and RAJC -1 and 2 were found superior in terms of high mean values for total yield per hectare. These genotypes may further be utilized in breeding programme with aim to improve total yield per hectare in carrot. The magnitude of the phenotypic coefficient of variation was higher than corresponding genotypic coefficient of variation for all the characters which indicated effect of environment on the character expression. Higher estimates genotypic (GCV) and phenotypic coefficient of variation (PCV) were observed

for carotene content followed by number of leaves per plant and root length. On the basis of correlation analysis it can be concluded that selection would be rewarding for such a genotype having more fresh weight of root, root length, number of leaves and leaf length as these traits were positively correlated with total yield per hectare. On the basis of path analysis, it can be concluded that selection should be done for such a genotype having high fresh root weight, root: shoot ratio, number of leaves for bringing improvement in yield. Fresh root weight, root: shoot ratio, root length and number of leaves were found to be the important character for increasing the yield potential in carrot.

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