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Genetic Variability, Heritability and Character Association in Coriander Genotypes (*Coriandrum sativum* L.) under Allahabad Agro-Climatic Condition

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ABSTRACT

The experiment was conducted on 15 genetically different genotypes under Allahabad agro-climatic condition. It was laid out in Randomized Block Design with 3 replications. It was observed that 9904 genotype was found superior in term of seed yield per plant. The phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the traits. Heritability in broad sense was noticed high for all the traits except test weight (1000-seeds) higher genetic advance was observed for plant height. High genetic advance as percent of mean was found in number of seeds per umbel. The traits like plant height, primary branches per plant, number of umbels per plant, number of umbellates per umbel, umbel diameter, number of seeds per umbel and test weight (1000-seeds) showed positive significant correlation with seed yield per plant at phenotypic and genotypic level. Number of seeds per umbel exhibited the highest positive direct effect at genotypic level.

Key words: *Coriander, Heritability, Genetic Advance, Correlation, Path Analysis*

INTRODUCTION

Coriander (*Coriandrum sativum* L.) is an annual spice herb that belongs to the family Umbelliferae/Apiaceae Jain *et al.*[10] Coriander is a diploid cross pollinated crop. Coriander is native to South-Eastern Europe and grown extensively all over the Europe, Middle East, China, India, and Turkey. It is recognized as cilantro in the west. This herbaceous plant grows up to 2 feet in height with branching stems, featuring deep-green soft, hairless bi-lobe or tri-lobed leaves. The mature plant bears small light pink color flowers that subsequently turn into globular or oval-shaped fruits (seeds). The seeds measure about 4-6 mm in diameter with a central hollow cavity containing two vertical vittae containing some important essential oils. Coriander seeds can be ready for harvest when the plant turn brown, and its leaves begin to dry and fall. Immature seeds are light green and taste bitter. To harvest; cut the crop, tie in small bundles, and sun-dry for several days. Traditionally, to separate the seeds, either the sheaves beaten with a stick or a lightweight roller employed to wear off the pods[4].

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Its seeds are an excellent source of minerals like iron, copper, calcium, potassium, manganese, zinc and magnesium. Copper is essential for the production of red blood cells. Coriander seeds contain an ample amount of vitamin-C. Furthermore, the seeds are the storehouse of many vital B-complex vitamins like thiamin, riboflavin, and niacin.

India is the biggest producer, consumer and exporter of coriander in the world with an annual production averaging around four lakh tonnes. Coriander for seed cultivation is grown as a *rabi* crop with sowing undertaken during October - November and new crop arrivals seen in February – March. India annually exports around 30,000 - 45,000 tonnes of coriander a year. India exported 35,902 tonnes of coriander in 2013. The major buyers were Malaysia (9252,17 tonnes), UAE (5858,57 tonnes), Saudi Arabia (3041,72 tonnes), Nepal (2485,98 tonnes), South Africa (2126,20 tonnes), U.K. (2005,95 tonnes) and Pakistan (1658,92 tonnes). The major domestic buyers of coriander seed in India are spice processing agencies, which consume around 50% of the production are mostly located in the southern states of India and Delhi. Uttar Pradesh spices are grown in an area of near about 6732 ha with production of 3684 tonne. The share of Uttar Pradesh in total production of spices in India is 3.41 % [3].

Heritability is estimated either performing analysis of variance or regressing the value of the offspring on the mean value of the parents. An important aspect of heritability estimates is that it applies to a particular environment at a particular time. Heritability has been used as an index of transmissibility of a character from the parent to its offspring[11] and thus an aid to foresee the improvement that can be made in a crop by selection for various characters. Genetic advance has an added advantage in selection, breeding programme. The correlation coefficient becomes more evident when genotypic correlations are partitioned into its components in path analysis in order to determine the relative magnitude of various attributes contributing to correlation. Path coefficient provides an effective means of entangling direct and indirect causes of association and measures the relative importance of each causal factor. Partitioning of total correlation into direct and indirect effect would be worthwhile for an effective selection program. The method of path coefficient was sought by Dewey and Lu[8] as a means of analyzing correlation coefficients.

MATERIALS AND METHODS

The present investigation "Genetic Variability, Heritability and Character Association in Coriander Genotypes (*Coriandrum sativum* L.) under Allahabad agro-climatic condition" during the *Rabi* season. The experiment was conducted in the Vegetable Research Farm, Department of Horticulture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad (Uttar Pradesh. All the facilities necessary for cultivation, including labour were made available in the department. The experimental material for this study comprised 15 genotypes collected from Research Institute. Genotypes and commercial checks are 9003, 8904, 2020, 8909, 9807, 9904, 8912, 9501, Azad D-1, Azad D-2, Jawahar D-1, Simpo-33, NDCOR-30, NDCOR-2, NDCOR- 67 The present experiment was conducted in Randomized Block Design with 18 treatments. The treatments are replication three times. Observation of each plant and therefore the technique of representative sampling was adopted for recording the observation from each plot, five plants were randomly selected and observations were recorded for morphological characters at successive stages of growth Plant height, Days to flowering, Days to maturity, rimary branches, Secondary branches, Number of umbels per plant, Number of umbellets per umbel, Number of seeds per umbel, Umbel diameter, 1000-seeds weight (g), Seed yield (g).

RESULTS AND DISCUSSION

Analysis of variance was done for partitioning the total variance into total variation due to the treatments and replications according to procedure Panse and Sukhatme[14]. The analysis of variance show significant difference among all the genotypes, for all the traits studies indicating presence of significant variability in the materials (Table-1).

Table 1: Analysis of variance for 11 characters in 15 Coriander genotypes.

Sl.N.	Parameters	Mean sum of squares		
		Replication ***D.f.*=2**	**Treatments** ***D.f.*=14**	**Error** ***D.f.*=28**
1	Plant height (cm)	3.83	364.65**	1.06
2	Days to flowering	0.28	62.76**	0.77
3	Days to maturity	0.40	35.09**	0.21
4	Primary branches per plant	0.016	4.98**	0.05
5	Secondary branches per plant	0.011	20.63**	0.15
6	Number of umbels per plant	0.046	213.85**	0.11
7	Number of umbellates per umbel	0.038	2.26**	0.028
8	Umbel diameter (cm)	0.018	1.014**	0.035
9	Number of seeds per umbel	0.042	114.82**	0.21
10	Test weight (1000 seed) (g)	0.133	3.66**	0.024
11	Seed yield per plant (g)	0.033	3.28**	0.26

** significant at 1% level of significance
* significant at 5% level of significance

The estimate of phenotypic coefficient of variation was higher than genotypic coefficient of variation among the all traits (Table-2).

The heritability in broad sense range from 82.1% (test weight) to 99.8% observed in number of umbels per plant Geremewa *et al.*[9] Similar observations were reported by Rajput, and Singh[16] and Singh *et al.*[21] in coriander.

Genetic advances was found highest in plant height (cm) 28.93 and 22.57 at 1% and 5% respectively while the lowest genetic advance observed in umbel diameter (cm) 1.43) and 1.11 at 1% and 5% respectively Meena *et al*[12]. Similar observations were reported by Dyulgerov and Dyulgerova[7] and Vijayalatha and Chezhiyan[23] in coriander.

Table 2: Coefficient of variations, genetic variability heritability, genetic advance and genetic advance as percent of mean for 11 traits in coriander genotypes

Character	GV	PV	CV		h2 (bs) (%)	GA		GA as percent on mean	
			GCV	PCV		1%	5%	1%	5%
Plant height (cm)	121.194	122.262	9.748	9.791	0.991	28.936	22.579	25.623	19.994
Days to flowering	20.665	21.439	6.154	6.269	0.964	11.782	9.194	15.952	12.447
Days to maturity	111.626	11.841	2.769	2.795	0.982	8.920	6.960	7.244	5.652
Primary branches per plant	1.641	1.698	16.837	17.126	0.966	3.325	2.595	43.699	34.099
Secondary branches per plant	6.827	6.986	12.468	12.613	0.977	6.819	5.321	32.539	25.390
Number of umbels per plant	71.246	71.366	15.933	15.946	0.998	22.265	17.373	42.027	32.794
Number umbellates per umbel	0.744	0.773	11.504	11.724	0.963	2.234	1.744	29.802	23.254
Umbel diameter (cm)	0.326	0.362	10.963	11.547	0.901	1.432	1.117	27.480	21.443
Number of seeds per umbel	38.206	38.416	17.940	17.990	0.995	16.273	12.698	47.233	36.856
Seed yield per plant (g)	1.086	1.113	7.624	7.717	0.976	2.718	2.121	19.885	15.516
Test weight (1000 seed) (g)	1.139	1.386	11.990	13.229	0.821	2.553	1.992	28.689	22.386

GV= Genotypic variance, PV= Phenotypic variance, GCV= Genotypic coefficient of variation, PCV= Phenotypic coefficient of variation, h2 (bs) = Heritability (broad Sense), GA=Genetic advance, GAM= Genetic advance as percent of mean.

Seed yield per plant significant and positively correlated with plant height days to maturity, primary branches per plant, secondary branches per plant, number of umbel per plant, number of umbellates per plant, umbel diameter number of seeds/umbel while days to flowering which was show negative correlations with seed yield per plant at genotypic level[1]. Similar observations were reported by Patel *et al.*[15], and Shah *et al.*[18] in coriander.

Phenotypic correlation seed yield per plant significant and positively correlated with plant height (cm) days to maturity, primary branches per plant, secondary branches per plant, number of umbel per plant, number of umbellates per plant, umbel diameter, number of seeds/umbel while days to flowering which was show negative correlations with seed yield per plant at phenotypic level Tehlan *et al*[22]. Similar observations were reported by Sade *et al.*[17], and Jain *et al.*[10] in coriander.

Path analysis indicate very high positive and direct effect to plant height (cm), days to maturity, secondary branches per plant, number of umbellates per umbel, number of seeds per umbel on seed yield per plant (g) at genotypic level. Similar observations were reported by Bandelasravanthi *et al.*[5] and Meena *et al.*[13] in coriander.

Days to flowering, primary branches per plant, number of umbels per plant, umbel diameter and test weight (1000 seed) had negative direct effect on seed yield per plant (g) at genotypic level. Path analysis indicate positive direct effect to plant height (cm), days to maturity, secondary branches per plant, number of umbels per plant, number of umbellates per umbel and test weight on seed yield per plant at phenotypic level. Days to flowering, primary branches per plant, umbel diameter (cm), and number of seeds per umbel showed negative direct effect on seed yield per plant at phenotypic level. Based on mean performance for different genotype 9904 (15.64 g) seed yield per plant closely followed by NDCOR-2 (15.11 g) seed yield per plant were found them high yield, while the lowest yield recorded is NDCOR-30 (11.43g) seed yield per plant Tehlan *et al.*[22] and Singh and Shah[20]. Similar observations were reported by Singh *et al.*[19] and Beena *et al.*[6] in coriander.

Table 3: Genotypic and phenotypic correlation coefficient for 11 character for Coriander Genotypes

S.N.	Character		Plant height (cm)	Days to flowering	Days to maturity	Primary branches per plant	Secondary branches per plant	Number of umbels per plant	Number of umbellates per umbel	Umbel diameter (cm)	Number of Seeds per umbel	Test weight (1000 seed)(g)	Seed yield per plant (g)
1	Plant height (cm)	g	1.0000	-0.0793	0.1941	0.4970**	0.2211	0.3717*	0.3276*	0.3222*	0.2979*	0.3315*	0.3926**
		p	1.0000	-0.0748	0.1904	0.4867**	0.2202	0.3695*	0.3182*	0.2882	0.2945*	0.3028*	0.3829**
2	Days to flowering	g		1.0000	-0.2291	-0.3637*	-0.1568	-0.2421	-0.3201*	0.3822**	-0.1650	-0.2470	0.4286**
		p		1.0000	-0.2315	-0.3465*	-0.1647	-0.2381	-0.3137*	-0.3674*	-0.1638	-0.1956	-0.4289**
3	Days to maturity	g			1.0000	0.4683**	0.0514	0.3860**	0.4345**	0.4777**	0.3063*	0.3709**	0.5558**
		p			1.0000	0.4591**	0.0516	0.3798*	0.4288**	0.4569**	0.3028*	0.3329*	0.5471**
4	Primary branches per plant	g				1.0000	0.6947	0.7170**	0.8563**	0.7999**	0.8416**	0.9169**	0.6897**
		p				1.0000	0.6785**	0.7040**	0.8214**	0.7447**	0.8237**	0.8158**	0.6668**
5	Secondary branches per plant	g					1.0000	0.6644**	0.7310**	0.5586**	0.7141**	0.8336**	0.6348**
		p					1.0000	0.6559**	0.7134**	0.5271**	0.7071**	0.7405**	0.6257**
6	Number of umbels per plant	g						1.0000	0.8289**	0.6657**	0.8823**	0.7214**	0.8011**
		p						1.0000	0.8113**	0.6305**	0.8791**	0.6519**	0.7922**
7	Number of umbellates per umbel	g							1.0000	0.8705**	0.8216**	0.7920**	0.8805**
		p							1.0000	0.8011**	0.8052**	0.7186**	0.8534**
8	Umbel diameter (cm)	g								1.0000	0.7257**	0.7693**	0.6982**
		p								1.0000	0.6886**	0.6102**	0.6555**
9	Number of seeds per umbel	g									1.0000	0.9212**	0.6603**
		p									1.0000	0.8260**	0.6523**
10	Test weight (1000 seed)(g)	g										1.0000	0.7005**
		p										1.0000	0.6122**

Table 4: Genotypic and Phenotypic path coefficient analysis for seed per plant in Coriander Genotypes

S.N.	Character		Plant height (cm)	Days to flowering	Days to maturity	Primary branches per plant	Secondary branches per plant	Number of umbels per plant	Number of umbellates per umbel	Umbel diameter (cm)	Number of Seeds per umbel	Test weight (1000 seed) (g)	Seed yield/ plant (g)
1	Plant height (cm)	g	**0.6795**	-0.0539	0.1319	0.3377	0.1502	0.2526	0.2226	0.2189	0.2024	0.2252	0.3926
		p	**0.2137**	-0.0160	0.0407	0.1040	0.0471	0.0790	0.0680	0.0616	0.0629	0.0647	**0.3829**
2	Days to flowering	g	0.0451	**-0.5692**	0.1304	0.2070	0.0892	0.1378	0.1822	0.2175	0.0939	0.1406	-0.4286
		p	0.0172	**-0.2299**	0.0532	0.0797	0.0379	0.0547	0.0721	0.0845	0.0376	0.0450	**-0.4289**
3	Days to maturity	g	0.1669	-0.1970	**0.8599**	0.4027	0.0442	0.3319	0.3736	0.4107	0.2633	0.3189	0.5558
		p	0.0626	-0.0760	**0.3285**	0.1508	0.0169	0.1247	0.1409	0.1501	0.0994	0.1094	**0.5471**
4	Primary branches per plant	g	-0.8251	0.6039	-0.7775	**-1.6602**	-1.1534	-1.1903	-1.4216	-1.3279	-1.3972	-1.5222	0.6897
		p	-0.2549	0.1815	-0.2405	**-0.5238**	-0.3554	-0.3687	-0.4302	-0.3900	-0.4314	-0.4273	**0.6668**
5	Secondary branches per plant	g	0.2069	-0.1467	0.0481	0.6500	**0.9357**	0.6216	0.6839	0.5227	0.6681	0.7800	0.6348
		p	0.0583	-0.0436	0.0136	0.1795	**0.2646**	0.1736	0.1888	0.1395	0.1871	0.1960	**0.6257**
6	Number of umbels plant	g	-0.4984	0.3246	-0.5176	-0.9614	-0.8908	**-1.3408**	-1.1114	-0.8926	-1.1831	-0.9672	0.8011
		p	0.0876	-0.0564	0.0901	0.1669	0.1555	**0.2371**	0.1924	0.1495	0.2084	0.1546	**0.7922**
7	Number umbellates per umbel	g	0.4450	-0.4349	0.5903	1.1633	0.9930	1.1260	**1.3585**	1.1827	1.1162	1.0759	0.8805
		p	0.2247	-0.2215	0.3028	0.5800	0.5037	0.5728	**0.7061**	0.5656	0.5686	0.5074	**0.8534**
8	Umbel diameter (cm)	g	-0.1322	0.1569	-0.1961	-0.3283	-0.2293	-0.2733	-0.3573	**-0.4105**	-0.2979	-0.3158	0.6982
		p	-0.0297	0.0379	-0.0471	-0.0768	-0.0544	-0.0650	-0.0826	**-0.1031**	-0.0710	-0.0629	**0.6555**
9	Number of seeds umbel	g	0.6010	-0.3329	0.6178	1.6977	1.4404	1.7798	1.6573	1.4637	**2.0171**	1.8582	0.6603
		p	-0.0283	0.0157	-0.0291	-0.0791	-0.0679	-0.0844	-0.0773	-0.0661	**-0.0960**	-0.0793	**0.6523**
10	Test weight (g)	g	-0.2961	0.2206	-0.3313	-0.8189	-0.7445	-0.6443	-0.7073	-0.6871	-0.8228	**-0.8931**	**0.7005**
		p	0.0317	-0.0205	0.0349	0.0855	0.0776	0.0683	0.0753	0.0640	0.0866	**0.1048**	**0.6122**

Genotypic R square = 0.9793 Residual effect = 0.1439
Phenotypic R square = 0.9009 Residual effect = 0.3148

CONCLUSION

On the basis of performance of 9904 genotype was found superior in term of yield attributing traits. That is genotype gave maximum yield 15.65 (g) per plant with 11.20 (g) test weight (1000 seeds weight) (19 q seed yield per hectare). Large amount of variability exhibited in the genotype for selection. The traits like plant height (cm), Days to flowering, Primary branches per plant, Secondary branches per plant, Number of umbels per plant, Number of umbellates per umbel, Number of seeds per umbel, Umbel diameter. Test weight (1000-seeds) and Seed yield per plant (g) were found with high heritability coupled high genetic advance providing good scope for further improvement in advance generation. These findings are based on one year trial, further testing is needed to substantiate the results.

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