Received: 28 Oct 2022 | Revised: 12 Feb 2023 | Accepted: 18 Feb 2023

Electronic Journal of Plant Breeding

Research Article

Analysis of variability and genetic divergence for seed yield in coriander (*Coriandrum sativum* L.)

Sourav Kumar Moharana[1*], Madhu Bala[1], A.Chakote Ankita[2], V. Manasa[1], Y. K. V. Naveen[1] and A. V. Malaviya[1]

[1]Department of Genetics and Plant Breeding, Navsari Agricultural University, Navsari, Gujarat, 396 450
[2]Department of Biochemistry, Navsari Agricultural University, Navsari, Gujarat, 396 450
[*]**E-Mail:** souravswati1@gmail.com

Abstract
Thirty-seven genotypes of coriander including six check varieties were analyzed for variability, correlation, path coefficients, and genetic divergence. Genotypes were grown in RBD with three replications and observations were recorded for 13 different quantitative traits. Secondary branches per plant and total oil content confirmed high values of GCV and PCV. Seeds per umbel, test weight, and total oil content exhibited high heritability along with high GA (% of mean). Both genotypically and phenotypically, seed yield per plant exhibited a positive and significant association with umbels per plant, umbellates per umbel, test weight, and harvest index. On seed yield per plant, umbels per plant reported the highest positive direct effect. Genetic diversity analysis grouped the 37 coriander genotypes into 6 different clusters with the maximum inter-cluster distance seen between clusters III and VI. Among the thirteen traits, test weight contributed largely to the total genetic divergence.

Keywords: Coriander, Heritability, Correlation, Path analysis, Diversity

INTRODUCTION

The Apiaceae family includes coriander (*Coriandrum sativum* L.), which has the somatic chromosomal number 2n=22. One of the two species in the genus *Coriandrum* is *C. tordylium*, the wild species, and the other is *C. sativum*, the cultivated one (Hedge and Lamond, 1972). It is grown for its green leaves used to prepare chutney, dried leaves, and seeds used as spices. Fatty acids and essential oils obtained from its dried fruit can be applied commercially in fragrance, food and beverages, pharmaceutical, cosmetic, plastic, and detergent industries. In India, it is mostly raised in the marginal lands of Gujarat, Madhya Pradesh, Andhra Pradesh, Rajasthan, and Tamil Nadu. The country's annual production of coriander seeds was over 822 thousand metric tons in the year 2020-2021 (Anonymous, 2021). To produce coriander cultivars with a broad genetic base, higher seed yield potential, and sustainability in production of coriander seeds, it is necessary to screen elite germplasms for the presence of genetic variability, generally considered as the heart of any plant breeding programme, not only the size of accessions but also the heterogeneity within them. Genetic diversity among the germplasm was studied to aid in the advancement of superior recombinants, by selecting parents with maximal genetic divergence which in general are the most appropriate for genetic improvement (Arunachalam, 1981). Coriander being a highly cross-pollinated crop is generally preferred to be improved through mass or recurrent selection. Hence, the present investigation was undertaken to study the genetic diversity and genetic variability among coriander genotypes for formulation of suitable selection indices for improvement in this crop.

https://doi.org/10.37992/2023.1401.018

MATERIALS AND METHODS

Thirty-seven different genotypes of coriander (**Table 1**) were evaluated during *Rabi* 2021-22, in three replications using RBD at the Research Farm, Department of Genetics and Plant Breeding, NMCA, NAU, Navsari, Gujarat. Each plot contained 90 plants at 60 x 10 cm^2 inter-row and intra-row spacing, respectively. The soil in the experimental plot was medium black, with a pH between 7.5 to 7.8 and had moderate to poor drainage with good water holding capacity. Geographically, Navsari is situated at 72^0 53' East longitudes and 20^0 55' North latitudes. The season was favorable throughout the growth duration and good agronomic practices were adopted which led to a successful and healthy crop stand. At the harvesting stage, from each plot of the three replications (excluding the border rows), five randomly selected plants were tagged and utilized to record the observations for the following traits: primary branches per plant, secondary

Table 1. List of coriander genotypes used in study

Treatment No.	Genotypes	Source of collection
1	NC-101	NMCA, NAU, Navsari
2	NC-102	NMCA, NAU, Navsari
3	NC-104	NMCA, NAU, Navsari
4	NC-105	NMCA, NAU, Navsari
5	NC-108	NMCA, NAU, Navsari
6	NC-111	NMCA, NAU, Navsari
7	NC-118	NMCA, NAU, Navsari
8	NC-119	NMCA, NAU, Navsari
9	NC-122	NMCA, NAU, Navsari
10	NC-124	NMCA, NAU, Navsari
11	NC-132	NMCA, NAU, Navsari
12	NC-136	NMCA, NAU, Navsari
13	NC-142	NMCA, NAU, Navsari
14	NC-143	NMCA, NAU, Navsari
15	NC-144	NMCA, NAU, Navsari
16	NC-145	NMCA, NAU, Navsari
17	NC-146	NMCA, NAU, Navsari
18	NC-148	NMCA, NAU, Navsari
19	NC-149	NMCA, NAU, Navsari
20	NC-150	NMCA, NAU, Navsari
21	NC-156	NMCA, NAU, Navsari
22	NC-157	NMCA, NAU, Navsari
23	NC-159	NMCA, NAU, Navsari
24	NC-160	NMCA, NAU, Navsari
25	NL-3	NMCA, NAU, Navsari
26	NL-5	NMCA, NAU, Navsari
27	NL-7	NMCA, NAU, Navsari
28	NL-8	NMCA, NAU, Navsari
29	NL-10	NMCA, NAU, Navsari
30	NL-12	NMCA, NAU, Navsari
31	NL-13	NMCA, NAU, Navsari
32	GDLC-1 (SC)	NMCA, NAU, Navsari
33	GC-2 (SC)	Jagudan, SDAU, Gujarat
34	GC-3 (SC)	Jagudan, SDAU, Gujarat
35	Rcr-728 (NC)	SKNCA, Jobner, Rajasthan
36	Hisar Anand (NC)	Hisar, Haryana
37	Arka Isha (NC)	NMCA, NAU, Navsari

Note: Germplasm used here are outcomes of Mass Selection branches per plant, plant height (cm), umbels per plant, umbellates per umbel, seeds per umbel, seed yield per plant (g), seed yield per plot (kg), test weight (g), harvest index (%) and total oil content (%). Data on days to 50 % flowering and days to maturity were taken on a population basis. The seed oil was estimated by the Soxhlet oil extraction method at Central Instrumentation Laboratory, Department of Soil Science and Agricultural Chemistry, NMCA, NAU, Navsari.

Biometrical analysis was done using the method suggested by Panse and Sukhatme (1978) for analysis of variance (ANOVA); Burton and Devane (1953) for coefficients of variation; Johnson *et al*. (1955) for heritability (broad sense) and genetic advance; Miller *et al*. (1958) for correlation coefficients; Dewey and Lu (1959) for path coefficient and diversity analysis was worked out by using Mahalanobis D^2 statistic as suggested by P. C. Mahalanobis (1936).

RESULTS AND DISCUSSION

Mean squares for each trait revealed the presence of significant differences among the genotypes for all the traits studied, demonstrating sufficient genotype-to-genotype variation (**Table 2**). Parameters of variability, presented in **Table 3**, showed higher genotypic variance than environmental variance for all the traits, except primary branches per plant, umbels per plant, harvest index, seed yield per plant, and seed yield per plot. This implied that there is considerable genotypic effect on phenotypic expression for the traits concerned. Secondary branches per plant and total oil content showed higher GCV and PCV values demonstrating a significant amount of inherent variation among the genotypes and selection can be done based on the above traits. Primary branches per plant, seeds per umbel, test weight and harvest index revealed moderate GCV and PCV depicting that selection for these traits will be less efficient. Lower values of GCV and PCV were observed for days to 50% flowering, plant height, days to maturity and umbellates per umbel limiting the scope of selection. Umbels per plant, seed yield per plant, and seed yield per plot showed moderate GCV and greater PCV suggesting that there is still a sizeable degree of inborn variation present among the genotypes, but that the plausible variation is not just due to genotypes but also to the beneficial impacts of the environment. Sometimes, selection for these traits can be misleading. Similar results were reported for days to flowering (Saroj *et al*., 2022), days to maturity (Acharya *et al*., 2020), plant height (Yadav *et al*., 2021), primary branches per plant (Didal *et al*., 2021), secondary branches per plant (Farooq *et al.,* 2017), umbels per plant (Patel *et al*., 2018), umbellates per umbel (Rajbhar *et al*., 2021), seeds per umbel (Verma *et al*., 2018), test weight (Choudhary *et al*., 2021), harvest index (Acharya *et al*., 2020) and total oil content (Desai *et al*., 2018).

High heritability was estimated for days to 50 % flowering, plant height, days to maturity, umbellates per umbel, seeds per umbel, test weight, and total oil content; heritability was moderate for primary branches per plant, secondary branches per plant, umbels per plant, seed

Table 2. Analysis of variance for 13 discrete characters of coriander

Sources of variation	d.f.	Days to 50 % flowering	Days to maturity	Plant height (cm)	Primary branches per plant	Secondary branches per plant	Umbels per plant	Umbellates per umbel
Replication	2	1.162	1.703	63.860	2.514	6.526	32.023	0.245
Genotypes	36	43.102**	120.600**	221.474**	2.701**	125.317**	148.742**	0.793**
Error	72	2.699	6.129	23.268	0.910	29.027	53.603	0.092
SEm ±		0.949	1.429	2.785	0.551	3.111	4.227	0.175
CD at 5 %		2.674	4.029	7.851	1.553	8.769	11.917	0.494
CV %		3.140	2.636	4.175	15.121	22.791	22.897	5.133

Table 2 contd…

Sources of variation	d.f.	Seeds per umbel	Seed yield per plant (g)	Test weight (g)	Seed yield per plot (kg)	Harvest index (%)	Total oil content (%)
Replication	2	56.294	0.065	0.004	0.004	64.889	0.047
Genotypes	36	108.762**	10.890**	18.265**	0.088**	96.095**	20.654**
Error	72	10.270	2.936	0.023	0.029	24.039	0.212
SEm ±		1.850	0.989	0.087	0.098	2.831	0.266
CD at 5 %		5.216	2.789	0.244	0.276	7.980	0.750
CV %		9.505	19.647	1.116	21.63	10.432	4.115

Note: ** indicate significance at 1%.

Table 3. Variability parameters for 13 contrasting characters of coriander

S. No.	Character	Range	Mean	Components of variance			GCV (%)	PCV (%)	h^2_{bs} (%)	Genetic advance	GA (% of mean)
				σ^2_g	σ^2_p	σ^2_e					
1	DFF	45.00-59.67	52.32	13.47	16.17	2.70	7.01	7.68	83.30	6.90	13.19
2	DM	85.67-106.33	93.92	38.16	44.29	6.13	6.58	7.09	86.16	11.81	12.58
3	PH	98.73-131.63	115.53	66.07	89.34	23.27	7.04	8.18	73.95	14.40	12.46
4	PB	4.73-8.33	6.31	0.60	1.51	0.91	12.25	19.46	39.62	1.00	15.88
5	SB	15.40-38.33	23.64	32.10	61.12	29.03	23.97	33.07	52.51	8.46	35.78
6	UP	19.13-48.80	31.98	31.71	85.32	53.60	17.61	28.89	37.17	7.07	22.12
7	UU	5.13-7.23	5.92	0.23	0.33	0.09	8.17	9.65	71.71	0.84	14.26
8	SU	25.73-46.77	33.72	32.83	43.10	10.27	16.99	19.47	76.17	10.30	30.55
9	YP	5.09-13.01	8.72	2.65	5.59	2.94	18.67	27.10	47.45	2.31	26.49
10	TW	8.29-18.24	13.44	6.08	6.10	0.02	18.34	18.38	99.63	5.07	37.72
11	SYPP	0.46-1.17	0.78	0.02	0.05	0.03	17.94	28.11	40.74	0.19	23.59
12	HI	28.79-61.64	47.00	24.02	48.06	24.04	10.43	14.75	49.98	7.14	15.19
13	TOC	7.54-19.66	11.20	6.81	7.03	0.21	23.30	23.67	96.98	5.30	47.28

DFF = Days to 50 % flowering, DM = Days to maturity, PH = Plant height (cm), PB = Primary branches per plant, SB = Secondary branches per plant, UP = Umbels per plant, UU = Umbellates per umbel, SU = Seeds per umbel, YP = Seed yield per plant, TW = Test weight (g), SYPP = Seed yield per plot (kg), HI = Harvest index (%), TOC = Total oil content (%)

yield per plant, seed yield per plot and harvest index. This is similar to the reports of plant height (Acharya *et al*., 2020), secondary branches per plant (Mayura and Devi 2016) and seeds per umbel (Desai *et al*., 2018). Our reports contradict with the findings of Yadav *et al*. (2021) and Saroj *et al*. (2022) for umbels per plant; with Dhakad *et al*. (2017) and Choudhary *et al*. (2021) for seed yield per plot. Selection for enhancement of such traits built on moderate to high heritability may not be effective, because broad sense heritability is predicted based on total genetic variance which encompasses both fixable and non-fixable variances. Therefore, traits are better evaluated when heritability is combined with genetic advance as per cent of mean.

Seeds per umbel, test weight and total oil content were observed to have high heritability along with high genetic advance as per cent of mean revealing the preponderance of additive gene effect indicating the effectiveness of selection. Days to 50% flowering, days to maturity, plant height and umbellates per umbel showed high heritability and moderate genetic advance as per cent of mean, indicating that non-additive gene action primarily controls these characters. As a result, there is not much scope for selection when it comes to these traits. Moderate heritability and high genetic advance as per cent of mean were noted for secondary branches per plant, umbels per plant, seed yield per plant and seed yield per plot. The environment has a major impact on these traits, which accounts for their medium heritability. These traits may be enhanced by selection, as indicated by the high genetic advance as per cent of mean. Primary branches per plant together with harvest index showed moderate heritability along with moderate genetic advance as per cent of mean which limited our chance to select for these traits. The findings are consistent with earlier reports for days to 50 % flowering (Desai *et al*., 2018), days to maturity (Patel *et al*., 2018), umbellates per umbel (Verma *et al*., 2018), test weight (Choudhary *et al*., 2021), harvest index (Acharya *et al*., 2020) and total oil content (Desai *et al*., 2018).

A study of correlation coefficients (**Table 4**) revealed that seed yield per plant exhibited positive and significant associations with umbels per plant, umbellates per umbel, test weight, and harvest index at both genotypic and phenotypic levels which indicates the considerable contribution of these traits towards seed yield. It depicted positive and non-significant association with primary branches per plant, secondary branches per plant, and seeds per umbel at the genotypic level but positive and significant correlation at the phenotypic level. This finding revealed that the apparent correlation between traits is attributable to factors other than genes, such as the favorable effects of the environment, demonstrating less significance of these traits for improvement. Seed yield per plant exhibited negative and significant association with days to 50% flowering and days to maturity at both the genotypic and phenotypic levels, suggesting the selection of such genotypes showing early flowering and brief maturation period may be practiced. The results support previous studies for days to 50 % flowering (Kumar *et al*., 2022), days to maturity (Yadav and Barholia, 2015), primary branches per plant (Yadav and Barholia, 2015), umbels per plant (Anilkumar *et al*., 2019), harvest index (Kumar *et al*., 2022) and total oil content (Nagappa *et al*., 2017).

Table 4. Genotypic and phenotypic correlations of seed yield per plant with other characters of coriander

Traits	r	DFF	DM	PH	PB	SB	UP	UU	SU	TW	HI	TOC	YP
DFF	rg	1.000	0.860**	0.707**	0.478**	0.279^{NS}	-0.192^{NS}	0.020^{NS}	0.141^{NS}	-0.722**	-0.510**	0.043^{NS}	-0.599**
	rp	1.000	0.740**	0.618**	0.329**	0.224*	-0.034^{NS}	0.059^{NS}	0.118^{NS}	-0.654**	-0.335**	0.049^{NS}	-0.306**
DM	rg		1.000	0.679**	0.490**	0.423**	0.012^{NS}	-0.079^{NS}	0.066^{NS}	-0.691**	-0.374*	-0.006^{NS}	-0.412*
	rp		1.000	0.543**	0.255**	0.206*	-0.084^{NS}	-0.073^{NS}	0.074^{NS}	-0.642**	-0.280**	-0.011^{NS}	-0.297**
PH	rg			1.000	0.435**	0.419**	0.119^{NS}	-0.112^{NS}	-0.015^{NS}	-0.390*	-0.258^{NS}	-0.040^{NS}	-0.284^{NS}
	rp			1.000	0.181^{NS}	0.284**	0.121^{NS}	-0.052^{NS}	-0.075^{NS}	-0.333**	-0.165^{NS}	-0.024^{NS}	-0.114^{NS}
PB	rg				1.000	0.915**	0.489**	0.263^{NS}	0.418*	-0.648**	-0.190^{NS}	-0.242^{NS}	0.046^{NS}
	rp				1.000	0.753**	0.590**	0.268**	0.353**	-0.396**	0.071^{NS}	-0.170^{NS}	0.331**
SB	rg					1.000	0.732**	0.262^{NS}	0.331*	-0.301^{NS}	0.048^{NS}	-0.127^{NS}	0.313^{NS}
	rp					1.000	0.789**	0.244**	0.261**	-0.204*	0.145^{NS}	-0.085^{NS}	0.502**
UP	rg						1.000	0.143^{NS}	0.093^{NS}	0.116^{NS}	0.174^{NS}	-0.102^{NS}	0.720**
	rp						1.000	0.181^{NS}	0.087^{NS}	0.089^{NS}	0.278**	-0.054^{NS}	0.737**
UU	rg							1.000	0.836**	-0.202^{NS}	0.275^{NS}	-0.085^{NS}	0.360*
	rp							1.000	0.761**	-0.163^{NS}	0.202*	-0.052^{NS}	0.300**
SU	rg								1.000	-0.412*	0.163^{NS}	-0.220^{NS}	0.315^{NS}
	rp								1.000	-0.358**	0.137^{NS}	-0.175^{NS}	0.218*
TW	rg									1.000	0.336*	0.294^{NS}	0.415*
	rp									1.000	0.241*	0.290**	0.307**
HI	rg										1.000	0.079^{NS}	0.463**
	rp										1.000	0.067^{NS}	0.420**
TOC	rg											1.000	-0.141^{NS}
	rp											1.000	-0.089^{NS}
YP	rg												1.000
	rp												1.000

Note: *, ** Significant at 5.0 and 1.0 per cent level, respectively; Seed yield per plot (kg) being the product of seed yield per plant (g) and number of plants per plot, was excluded to avoid inflation due to multi-collinearity.

Genotypic path coefficient analysis (**Table 5**) was carried out to have more in-depth knowledge of the essential force responsible for the given correlation and the relative relevance of each causal factor. Highest positive direct effect was observed for umbels per plant with a very high significance of correlation with seed yield. Similarly, the highest negative direct effect with a negative significant correlation was found for days to 50 % flowering. Similar outcomes were reported for days to 50 % flowering by Choudhary *et al*., 2021 and umbels per plant by Kumar *et al*., 2022. The residual effect at the genotypic level was 0.0971 which indicated that about 90 per cent of the yield contributing traits for the population studied have been covered.

A study of genetic diversity categorized all the thirty-seven genotypes of coriander into six clusters (**Table 6** and **Fig.1**), based on Tocher's method (Rao, 1952). Cluster I (16 genotypes) had a maximum number of genotypes followed by cluster II (14 genotypes), cluster III (4 genotypes), and clusters IV, V, and VI, which had only one genotype each. A close study of data in **Table 7** showed that the maximum inter-cluster distance was traced between clusters III and VI indicating possibilities of obtaining good array of variability upon inter-crossing. The minimum inter-cluster distance was observed between clusters IV and VI. The maximum intra-cluster distance was observed within cluster I followed by cluster II (**Fig.2**). Results of the present study match with the reports of Mengesha *et al*. (2011), Awas *et al*. (2017) and others where it was not possible to establish a formal link between geographic diversity and genetic diversity. This may be because genetic diversity is the result of factors other than geographic isolation, such as artificial and natural selection, genetic drift, exchange of breeding material, and environmental variation.

The genotypes within cluster V showed higher mean values for days to 50 % flowering, plant height, days to maturity, secondary branches per plant, umbellates per umbel and total oil content. Similarly, cluster VI showed higher mean values for seed yield per plant, seed yield per plot, test weight, and harvest index. Genotypes within cluster III possessed higher mean values for primary

Table 5. Direct and indirect effects of various characters on seed yield per plant for 37 genotypes of coriander

Traits	DFF	DM	PH	PB	SB	UP	UU	SU	TW	HI	TOC	YP (r_g)
DFF	**-0.3128**	0.0345	0.0003	-0.2230	0.0415	-0.1385	-0.0014	0.0727	-0.0657	-0.0035	-0.0029	-0.5987^{**}
DM	-0.2691	**0.0402**	0.0003	-0.2288	0.0629	0.0084	0.0054	0.0341	-0.0629	-0.0026	0.0004	-0.4116^{*}
PH	-0.2213	0.0272	**0.0005**	-0.2032	0.0623	0.0856	0.0077	-0.0077	-0.0355	-0.0018	0.0027	-0.2835^{NS}
PB	-0.1495	0.0197	0.0002	**-0.4667**	0.1362	0.3531	-0.0181	0.2148	-0.0589	-0.0013	0.0163	0.0457^{NS}
SB	-0.0872	0.0170	0.0002	-0.4271	**0.1488**	0.5280	-0.0180	0.1702	-0.0274	0.0003	0.0086	0.3134^{NS}
UP	0.0600	0.0005	0.0001	-0.2283	0.1088	**0.7217**	-0.0098	0.0480	0.0106	0.0012	0.0069	0.7196^{**}
UU	-0.0061	-0.0032	-0.0001	-0.1229	0.0389	0.1031	**-0.0687**	0.4298	-0.0184	0.0019	0.0058	0.3601^{*}
SU	-0.0442	0.0027	0.0000	-0.1950	0.0493	0.0673	-0.0575	**0.5140**	-0.0375	0.0011	0.0149	0.3151^{NS}
TW	0.2257	-0.0277	-0.0002	0.3023	-0.0448	0.0838	0.0139	-0.2115	**0.0910**	0.0023	-0.0199	0.4148^{*}
HI	0.1596	-0.0150	-0.0001	0.0884	0.0071	0.1257	-0.0189	0.0836	0.0305	**0.0069**	-0.0054	0.4626^{**}
TOC	-0.0136	-0.0003	0.0000	0.1127	-0.0190	-0.0733	0.0059	-0.1130	0.0268	0.0006	**-0.0677**	-0.1409^{NS}

Note: Residual = 0.0971, Bold diagonal figures are the direct effects; YP (r_g)= Genotypic correlation with seed yield per plant; Seed yield per plot (kg) being the product of seed yield per plant (g) and number of plants per plot, was excluded to avoid inflation due to multi-collinearity.

Table 6. Distribution of 37 genotypes of coriander into six independent clusters based on Mahalanobis D^2 Statistic

Cluster	Number of genotypes	Name of genotypes
I	16	NC-102, NC-104, NC-105, NC-111, NC-119, NC-122, NC-124, NC-136, NC-143, NC-144, NC-146, NC-149, NC-150, NC-156, NC-157, NC-159
II	14	NC-101, NC-108, NC-118, NC-142, NC-145, NC-148, NL-3, NL-7, NL-13, GDLC-1 (SC), GC-2 (SC), GC-3 (SC), Rcr-728 (NC), Hisar-Anand (NC)
III	4	NL-8, NL-10, NL-12, Arka Isha (NC)
IV	1	NC-160
V	1	NL-5
VI	1	NC-132

Table 7. Average inter and intra-cluster (D^2) values for 37 genotypes of coriander

Clusters	I	II	III	IV	V	VI
I	14.02	27.12	53.60	21.12	26.48	28.80
II		12.19	30.38	36.88	30.02	50.30
III			10.71	63.39	52.37	78.02
IV				0.00	17.70	17.19
V					0.00	33.75
VI						0.00

branches per plant and seeds per umbel. Genotypes within clusters I and II showed higher mean values for umbels per plant and umbellates per umbel, respectively (**Table 8**). Among the traits studied, test weight contributed significantly to the total genetic divergence preceded by total oil content, umbellates per umbel, plant height, and days to maturity (**Fig. 3**).

In conclusion, the genotypes of coriander studied possess immense variability within and genetic diversity among themselves. Secondary branches per plant, seeds per umbel, umbels per plant, umbellates per umbel, harvest index, test weight and total oil content and can be suitably considered as selection indices targeting enhanced seed yield of the crop. Crossing between genotypes of cluster III and VI (most distant clusters) is likely to create superior progenies with good amount of variability upon which selection can be exercised.

https://doi.org/10.37992/2023.1401.018

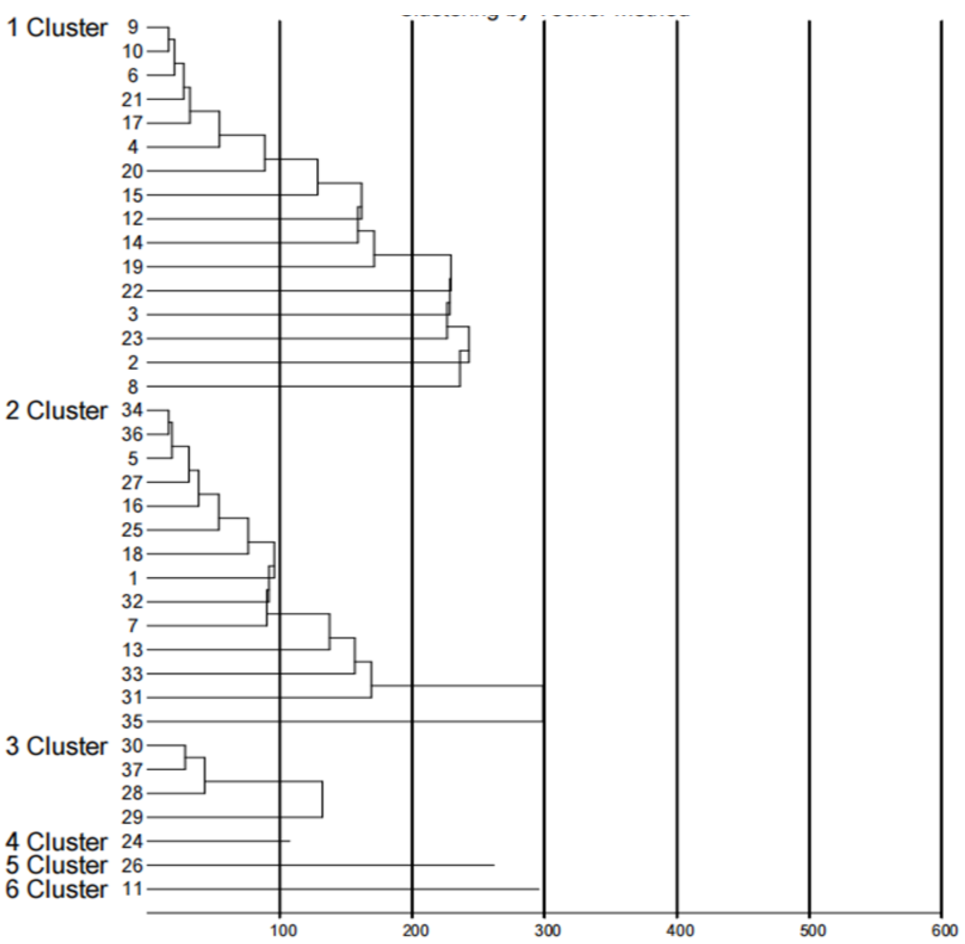

Fig. 1. Dendrogram of 37 genotypes of coriander based on thirteen traits

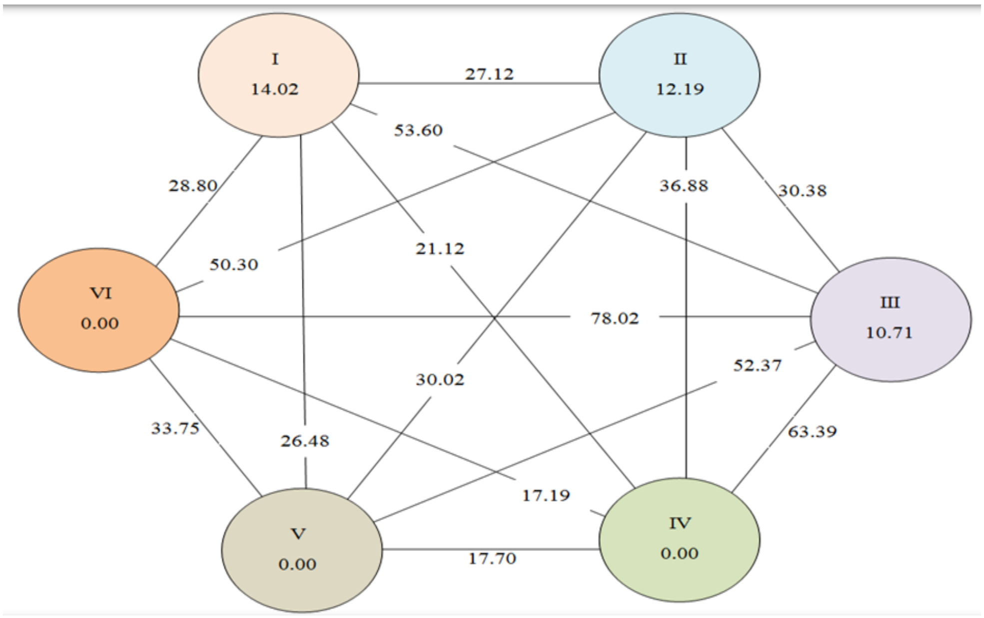

Fig. 2. Cluster diagram of 37 genotypes of coriander based on Mahalanobis D2 Statistic

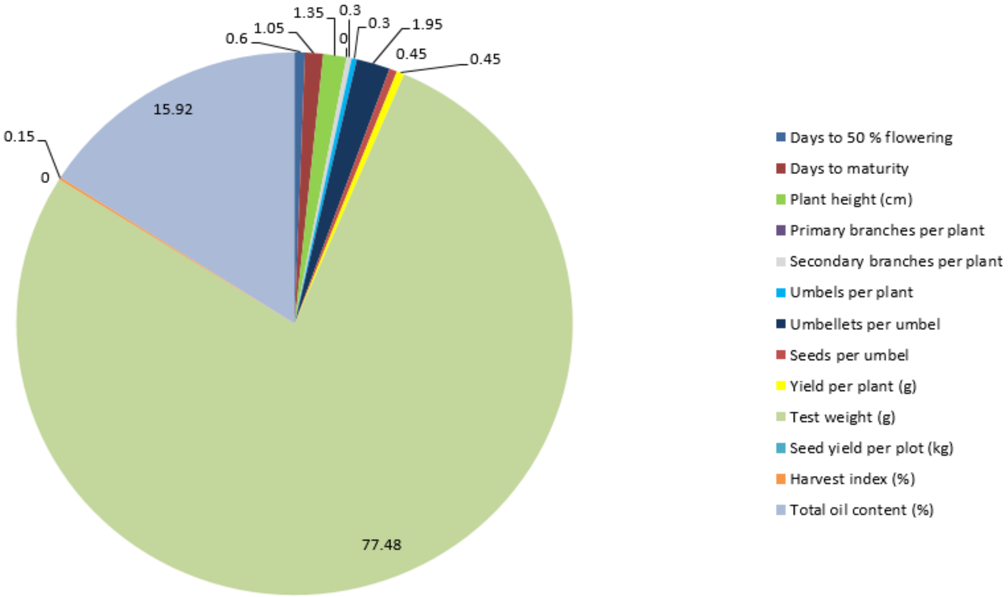

Fig. 3. Percentage contribution of 13 quantitative traits of coriander towards genetic divergence

Table 8. Cluster means for 13 characters in 37 genotypes of coriander

Cluster Number	Days to 50 % flowering	Days to maturity	Plant height (cm)	Primary branches per plant	Secondary branches per plant	Umbels per plant	Umbellates per umbel
I	49.58	90.23	113.07	5.99	22.65	**33.24**	5.80
II	53.98	95.33	117.15	6.55	24.51	31.78	**6.10**
III	57.25	103.83	120.91	**6.98**	25.30	29.00	5.84
IV	50.33	88.67	**108.87**	6.00	20.87	**28.60**	5.60
V	**59.67**	**106.33**	**121.57**	6.87	**29.27**	32.80	**6.10**
VI	**48.00**	**86.33**	111.33	**5.00**	**17.73**	29.00	**5.53**

Table 8. contd…

Cluster Number	Seeds per umbel	Seed yield per plant (g)	Test weight (g)	Seed yield per plot (kg)	Harvest index (%)	Total oil content (%)
I	32.40	9.41	15.23	0.85	48.22	10.61
II	34.92	8.33	12.20	0.75	46.19	10.87
III	**37.04**	7.35	**8.58**	**0.66**	45.17	**9.90**
IV	**28.95**	8.31	16.11	0.75	47.01	17.47
V	32.89	**7.29**	14.32	**0.66**	**42.68**	**19.66**
VI	30.27	**10.47**	**18.24**	**0.94**	**50.53**	15.73

Note: Bold figures represent minimum and maximum cluster means for each character.

ACKNOWLEDGEMENT

Authors are grateful to Department of Genetics and Plant Breeding (Voluntary Centre for AICRP on Seed Spices), NMCA, NAU, Navsari, for providing seeds and necessary materials for research. We are obliged to Dr. R. K. Patel, Dr. V. B. Parekh, Dr. Rehana Niyaria and Prof. A. P. Chaudhary for their constant support and guidance during the period of this investigation.

REFERENCES

Acharya, V. R., Singh, M., Patel, R. K. and Goyal, L. 2020.

Genetic diversity of coriander for yield and its attributing characters. *International Journal of Current Microbiology and Applied Science*, **9**(2): 222-228. [Cross Ref]

Anilkumar, G. S., Umesha, K., Shivapriya, M., Halesh, G. K., Maruthiprasad, B. N. and Darshan, G. 2019. Character association and path analysis for yield traits in coriander (*Coriandrum sativum* L.). *Electronic Journal of Plant Breeding*, **10**(1): 224-229. [Cross Ref]

Anonymous, 2021. Estimated production volume of coriander seed across India in FY 2021, by state. Statista Research Department.

Arunachalam, V. 1981. Genetic divergence in plant breeding. *Indian Journal of Genetics and Plant Breeding*, **14**: 226-236.

Awas, G., Mekbib, F. and Ayana, A. 2017. Genetic diversity analysis of Ethiopian coriander (*Coriandrum sativum* L.) genotypes for seed yield and oil content. *Journal of Plant Breeding and Genetics*, **5**(1): 07-14. [Cross Ref]

Burton, G. W. and De-vane, E. W. 1953. Estimating heritability in tall fescue (*Festuca arundiancea*) from replicated clonal material. *Proejtunniens*, **9**(22): 12-15.

Choudhary, V., Verma, P., Sharma, S. C., Yadav, D. L. and Narolia, R. S. 2021. Genetic variability and character association studies for yield and its contributing traits in coriander (*Coriandrum sativum* L.). *The Pharma Innovation Journal*, **10**(11): 1830-1834.

Desai, P. K., Asati, J. and Patel, R. K. 2018. Genetic variability analysis in coriander (*Coriandrum sativum* Linn.). *International Journal of Pure and Applied Bioscience*, **6**(6): 93-96. [Cross Ref]

Dewey, D. R. and Lu, K. 1959. A correlation and path-coefficient analysis of components of crested wheatgrass seed production. *Agronomy Journal*, **51**(9): 515-518. [Cross Ref]

Dhakad, R. S., Sengupta, S. K., Lal, N. and Shiurkar, G. 2017. Genetic diversity and heritability analysis in coriander. *The Pharma Innovation Journal*, **6**(8): 40-46.

Didal, B., Lal, G., Kaswan, P. K., Choudhary, G., Gupta, D. and Netwal, M. 2021. Genetic variability, heritability, genetic advance and coefficient of variance analysis in coriander (*Coriandrum sativum* L.). *The Pharma Innovation Journal*, **10**(7): 1531-1534.

Farooq, M., Hegde, R. V. and Imamsaheb, S. J. 2017. Variability, heritability and genetic advance in coriander genotypes. *Plant Archives*, **17**(1): 519-522.

Hedge, I. C. and Lamond, J. M. 1972. Coriandrum L. *Flora of Turkey*, **4**: 330-331.

Johnson, H. W., Robinson, H. R. and Comstock, R. E. 1955. Estimation of genetic and environmental variability in soybean (*Glycine max* L.). *Agronomy Journal*, **47**: 314-318. [Cross Ref]

Kumar, M. A., Choudhary, G., Garhwal, O. P. and Netwal, M. 2022. Correlation coefficient and path analysis for yield traits in coriander (*Coriandrum sativum* L.) genotypes. *Electronic Journal of Plant Breeding*, **13**(1): 253-257. [Cross Ref]

Mahalanobis, P. C. 1936. On generalized distance in statistics. *Proceedings of the National Institute India,* **2**: 49-55.

Mayura, K. R. and Devi, B. 2016. Genetic variability analysis in coriander (*Coriandrum sativum* L.) in agroclimatic condition of Jhansi, India. *International Journal of Current Research,* **84**(12): 1508-12.

Mengesha, B., Alemaw, G. and Tesfaye, B. 2011. Genetic divergence in Ethiopian coriander accessions and its implication in breeding of desired plant types. *African Crop Science Journal*, **19**(1): 39-47. [Cross Ref]

Miller, P. J., Willams, J. C., Robinsons, H. F. and Comstock, R. E. 1958. Estimates of genotypic and environmental variances and covariance in upland cotton and their implications in selection. *Agronomy Journal,* **50**: 126-131. [Cross Ref]

Nagappa, M. K., Giridhar, K. and Dorajeerao, A. V. D. 2017. Correlation between yield and its attributes in coriander. *Plant Archives*, **17**(2): 941-947. [Cross Ref]

Panse, V. G. and Sukhatme, P. V. 1978. Statistical methods for agricultural workers. ICAR, New Delhi, pp. 103-108.

Patel, D. G., Patel, P. R., Patel, H. B. and Patel, A. M. 2018. Assessment of genetic variability in coriander (*Coriandrum sativum* L.). *International Journal of Science and Research,* **8**(3): 629-632.

Rajbhar, R., Ram, C. N., Kumar, P., Rao, O. P. and Nath, S. 2021. Assessment of genetic variability, heritability and genetic advance in coriander (*Coriandrum sativum* L.). *The Pharma Innovation Journal,* **10**(8): 1585-1586.

Rao, C. R. 1952. Advanced statistical methods in biometric research. Jhon Wiley and Sons, New York, 357-369.

Saroj, R., Mishra, D. P., Ram, C. N. and Nath, S. 2022. Assessment of genetic variability in coriander

(*Coriandrum sativum* L). *South Asian Journal of Agricultural Sciences*, **2**(1): 13-15.

Verma, M. K., Pandey, V. P., Singh, D., Kumar, S. and Kumar, P. 2018. Studies on genetic variability in germplasm of coriander (*Coriandrum sativum* L.). *Journal of Pharmacognosy and Phytochemistry*, SP1:2490-2493.

Yadav, R. K., Mishra, D. P. and Yadav, G. C. 2021. Studies on genetic variability in coriander (*Coriandrum sativum* L.). *The Pharma Innovation Journal*, **10**(9): 1756-1760.

Yadav, S. and Barholia, A. 2015. Assessment of yield component traits in coriander over environments. *The Bioscan*, **10**(1): 355-358.

https://doi.org/10.37992/2023.1401.018