Experimental studies of Genetic Divergence in Coriander (*Coriandrum sativum* L.)

ABSTRACT

Research work on genetic divergence, analysis was estimated in 62 genotypes of coriander (*Coriandrum sativum* L.) grown in an Augmented Block Design during (*Ravi*) Summer season of 2019-20 atthe Main Experiment Station of theDepartment of Vegetable Science Acharya Narendra Deva University of Agriculture and Technology, Ayodhya. The objective of this study was to characterize morphological differences and yield related traits among 62 coriander genotypes. The estimation of genetic diversity among tested genotypes was highly significant, which got grouped into 10 clusters with cluster I comprising maximum genotypes. Cluster X (94.18) were observed as a maximum intra cluster distance pursued by cluster IV (74.26), cluster III (67.45), cluster II (64.43), cluster I (35.72). Similarly Inter-cluster distance maximum value was found between cluster IV with cluster X (575.40) were persued by cluster VII with cluster X (429.75), cluster II with cluster X (345.80). Although maximum cluster means for seed yield traits was recorded for VII and VI respectly, suggestation a wide range of diversity among most of the economic traits that would enable breeder to identify the genotypes with suitable traits should be used in direct selection and improvement also a programme according genetic divergence bases. 62 accession showed distinguished variation in the dendrogram for all the studied parameters.

Key word:Genetic Divergence, Coriander, Coriandrum sativum, Genetic diversity, Coriandrum sativum, Genetic Variability, Coriander genotypes

INTRODUCTION

"Coriander (*Coriandrum sativum* L.) is an important spice crop which belongs to family Apiaceae (Umbelliferae) and has a somatic chromosome number 2n = 22. Coriander is native to the Middle East and Mediterranean, and also found in Egypt and Sudan in wild form. Now it is extensively cultivated in India as well as in the world for its demand of both seeds and leaves as a spice, herb and flavouring food. The fresh fruits, leaves and stems of coriander have a pleasant aromatic odour. The entire plant of coriander (*Coriandrum sativum* L.) whenit is young is used in preparing(*sauce*) chutney, where the leaves are used for its flavouring the curries, sauce and soups. The grains are extensively employed as condiments in the preparation of curry powder, pickling, soups, sausages and seasoning. They are also added for flavouring pastry, cookies, buns, cakes and tobacco products. Inthe USA and Europe, coriander is employed for flavouring liquor, particularly gin. The fresh green seeds of coriander are also used to make(*soup*) 'Dhana dal' which is very popular in Gujarat state". [20]

"Coriander (*Coriandrum sativum* L.) seeds possess immense medicinalproperties and are considered values to be carminative, diuretic, tonic stomachic and refrigerant. They are also reported to lessen the intoxicating effect of spirituous liquors. An infusion of the seed in combination with cardamom and caraway seeds is useful against flatulence, indigestion, vomiting and intestinal disorders" (Purthi *et al.* 1998).

"The volatile essential oil compositions like terpenoids and phenolic constituents, are of great importance in the field of pharmacology. In addition, coriander (*Coriandrum sativum* L.) alone or in combination with the other herbal agents is used for dyspeptic complaints, loss of appetite, convulsion, insomnia and anxiety also found to improve blood glucose control and its use for as anti-hyperglycemic agent. In India it is mainly grown in Rajasthan, Haryana, Andhra Pradesh, Madhya Pradesh and Tamil Nadu. In India it is grown in 5,32,000 ha area with annual production of 7,10,000 MT and 1.0 MT per hectare productivity" (Anonymous 2018).

Coriander (*Coriandrum sativum* L.) is a smooth, erect annual herb with a long tap root, an erect and branching leafy stem (300-700mm), bipinnate leaves, the pinnae with broad wedge-shaped, toothed segments, the upper leaves becoming gradually more compressed with very narrow linear segment and those of uppermost almost setaceous. "The flowers are small actinomorphic; the peripheral flowers of an umbel are zygomorphic, hermaphrodite or sometimes unisexual or polygamous white or rose coloured in terminal umbels, calys of five teeth, obcordate, outer one radiant, bifid. Fruit schizocarp, globular, yellowish-brown, ribbed composed of two concavo-convex mericarp, with or without pedicels. Each mericarp has four, straight, primary ridges and five secondary ridges. Five calyx teeth and a short conical style complete the apex of the seed". [21]

The essential oil of coriander grains contains about 20 % is a valuable ingredient in perfumes. The green leaves contain 87.9 % moisture, 3.3 % protein, 6.5 % carbohydrate, 0.6 % fat and 21.7 % mineral matter. Dry seeds contain 6.3 % moisture, 0.3-0.4 % volatile oil, 1.3 % protein, 19.6 % non-volatile oil, 31.5 % total ether extract, 24.6 % carbohydrate, 5.3 % mineral matter and vitamin A (175 I.U./100gm). Good quality oleoresin is extracted from coriander seeds. The oleoresin is used for flavouring beverages, pickles and sweets. The residue from distillation can be used as fodder. Soluble coriander is prepared by properly blending and dispensing a minimum of 3 % of total extractive of coriander on a soluble, dry edible carrier.

Genetic divergence is the process in which two or more populations of an ancestral species accumulate independent genetic changes (mutations) through time, often after the populations have become reproductively isolated for some time or the separation of a population gene pool from the gene pools of other populations due to mutation, genetic drift, and selection. For crop improvement long-term programme in coriander germplasm is very important. The assessment of the genetic diversity is not only important for genotype conservation but also in parent selection for breeding

purposes. The biological variations in an organism are combined responses of genotypic, phenotypic and environmental components. The genotypic variation is of great importance froma crop improvement point of view and consists of heritable and non-heritable components. Keeping in given the above facts, the present investigation entitled "Study of genetic diversity, in coriander (*Coriandrum sativum* L.)" has been planned with the objectives of the estimating the genetic divergence (D^2)among the genotypes for various traits.

MATERIAL AND METHOD

Experiments were conducted at the main experiment station (Vegetable Research Farm), Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Ayodhya (U.P.) India, in well-leveled field with proper drainage facilities. This research farm is situated at the main campus of the University onthe left side of Ayodhya-Raebareli road at a distance of 42 km from the main city of Ayodhya district.Geographically, Narendra Nagar, Kumarganj is located between 24.47^0 and 26.56^0 N latitude and 82.12^0 and 83.98^0 E longitude at an altitude of 113 m above the mean sea level in the Gangetic Alluvial Plains of Eastern Uttar Pradesh of Ayodhya district.

EXPERIMENTAL DETAIL

In this experiment a total of62 genotypes of coriander maintained inthe All India Co-ordinated Research Project on Spices underthe Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology Narendra Nagar, Kumarganj, Ayodhya were taken for this investigation. These genotypes are collected from different places in India.The check varieties were Hisar Anand (HAU, Hisar) and ND Cor-2 (A.N.D.U.A.T Kumarganj Ayodhya).

Every germplasm were comprising of two row spaced 30 cm apart with plant-to-plant spacing of 15 cm. Observation was recorded for Days to 50% flowering, Plant height (cm), Nodes per plant, Branches per plant, Umbels per plant, Umbellates per umbel, Fruits per umbellate, Fruits per umbel, Umbel diameter (cm), 1000 seed weight (g), Seed yield per plant (g).

Through non-hierarchical Euclidean cluster analysis was employed to study the genetic divergence existing among 62 coriander genotypes including checks placed in augmented design, was investigated. The detailed description among different clusters are given under K- means clustering of standardized data was used to identify the more significant level of discrimination betbeen the cluster for each of variable.

Table 1. Genotypes passport data in table

S. No.	Genotypes	Sources
1	ND Cor-1	ANDUA&T, Kumarganj, Ayodhya (U.P.)
2	ND Cor-2	ANDUA&T, Kumarganj, Ayodhya (U.P.)
3	ND Cor-3	ANDUA&T, Kumarganj, Ayodhya (U.P.)
4	ND Cor-4	ANDUA&T, Kumarganj, Ayodhya (U.P.)
5	ND Cor-5	ANDUA&T, Kumarganj, Ayodhya (U.P.)
6	ND Cor-6	ANDUA&T, Kumarganj, Ayodhya (U.P.)
7	ND Cor-7	ANDUA&T, Kumarganj, Ayodhya (U.P.)
8	ND Cor-8	ANDUA&T, Kumarganj, Ayodhya (U.P.)
9	ND Cor-9	ANDUA&T, Kumarganj, Ayodhya (U.P.)
10	ND Cor-10	ANDUA&T, Kumarganj, Ayodhya (U.P.)
11	ND Cor-11	ANDUA&T, Kumarganj, Ayodhya (U.P.)
12	ND Cor-12	ANDUA&T, Kumarganj, Ayodhya (U.P.)
13	ND Cor-13	ANDUA&T, Kumarganj, Ayodhya (U.P.)
14	ND Cor-14	ANDUA&T, Kumarganj, Ayodhya (U.P.)
15	ND Cor-15	ANDUA&T, Kumarganj, Ayodhya (U.P.)
16	ND Cor-16	ANDUA&T, Kumarganj, Ayodhya (U.P.)
17	ND Cor-17	ANDUA&T, Kumarganj, Ayodhya (U.P.)
18	ND Cor-18	ANDUA&T, Kumarganj, Ayodhya (U.P.)
19	ND Cor-19	ANDUA&T, Kumarganj, Ayodhya (U.P.)
20	ND Cor-20	ANDUA&T, Kumarganj, Ayodhya (U.P.)
21	ND Cor-21	ANDUA&T, Kumarganj, Ayodhya (U.P.)
22	ND Cor-22	ANDUA&T, Kumarganj, Ayodhya (U.P.)
23	ND Cor-23	ANDUA&T, Kumarganj, Ayodhya (U.P.)
24	ND Cor-24	ANDUA&T, Kumarganj, Ayodhya (U.P.)
25	ND Cor-25	ANDUA&T, Kumarganj, Ayodhya (U.P.)
26	ND Cor-26	ANDUA&T, Kumarganj, Ayodhya (U.P.)
27	ND Cor-27	ANDUA&T, Kumarganj, Ayodhya (U.P.)
28	ND Cor-28	ANDUA&T, Kumarganj, Ayodhya (U.P.)
29	ND Cor-29	ANDUA&T, Kumarganj, Ayodhya (U.P.)
30	ND Cor-30	ANDUA&T, Kumarganj, Ayodhya (U.P.)
31	ND Cor-31	ANDUA&T, Kumarganj, Ayodhya (U.P.)

32	ND Cor-32	ANDUA&T, Kumarganj, Ayodhya (U.P.)
33	ND Cor-33	ANDUA&T, Kumarganj, Ayodhya (U.P.)
34	ND Cor-34	ANDUA&T, Kumarganj, Ayodhya (U.P.)
35	ND Cor-35	ANDUA&T, Kumarganj, Ayodhya (U.P.)
36	ND Cor-36	ANDUA&T, Kumarganj, Ayodhya (U.P.)
37	ND Cor-37	ANDUA&T, Kumarganj, Ayodhya (U.P.)
38	ND Cor-38	ANDUA&T, Kumarganj, Ayodhya (U.P.)
39	ND Cor-39	ANDUA&T, Kumarganj, Ayodhya (U.P.)
40	ND Cor-40	ANDUA&T, Kumarganj, Ayodhya (U.P.)
41	ND Cor-41	ANDUA&T, Kumarganj, Ayodhya (U.P.)
42	ND Cor-42	ANDUA&T, Kumarganj, Ayodhya (U.P.)
43	ND Cor-43	ANDUA&T, Kumarganj, Ayodhya (U.P.)
44	ND Cor-44	ANDUA&T, Kumarganj, Ayodhya (U.P.)
45	ND Cor-45	ANDUA&T, Kumarganj, Ayodhya (U.P.)
46	ND Cor-46	ANDUA&T, Kumarganj, Ayodhya (U.P.)
47	ND Cor-47	ANDUA&T, Kumarganj, Ayodhya (U.P.)
48	ND Cor-48	ANDUA&T, Kumarganj, Ayodhya (U.P.)
49	ND Cor-49	ANDUA&T, Kumarganj, Ayodhya (U.P.)
50	ND Cor-50	ANDUA&T, Kumarganj, Ayodhya (U.P.)
51	ND Cor-51	ANDUA&T, Kumarganj, Ayodhya (U.P.)
52	ND Cor-52	ANDUA&T, Kumarganj, Ayodhya (U.P.)
53	ND Cor-53	ANDUA&T, Kumarganj, Ayodhya (U.P.)
54	ND Cor-54	ANDUA&T, Kumarganj, Ayodhya (U.P.)
55	ND Cor-55	ANDUA&T, Kumarganj, Ayodhya (U.P.)
56	ND Cor-56	ANDUA&T, Kumarganj, Ayodhya (U.P.)
57	ND Cor-57	ANDUA&T, Kumarganj, Ayodhya (U.P.)
58	ND Cor-58	ANDUA&T, Kumarganj, Ayodhya (U.P.)
59	ND Cor-59	ANDUA&T, Kumarganj, Ayodhya (U.P.)

60	ND Cor-60	ANDUA&T, Kumarganj, Ayodhya (U.P.)
Check 1	Hisar anand	HAU, Hisar (H.R.)
Check 2	ND Cor-2	ANDUA&T, Kumarganj, Ayodhya (U.P.)

3. RESULT AND DISCUSSION

Following is a summary of the findings from the current study as well as relevant discussion. Selection ofsuitable parent plays an important role in a successful genetic divergence analysis. Many methods are available for estimating genetic diversity. Sixty-two genotypes of coriander taken for Euclidian analysis differed significantly about the characters under study and showed marked divergence, when taking all 11 characters together. Average inter and intra-cluster distanceswere calculated and exhibited in Table 2. Intra-cluster distance showed divergence among the genotypes with in a cluster while inner cluster distance showedrelative divergence among the cluster. The cluster mean for 11 character among 10 clusters are also presented in Table 3.

3.1 Clustering of Genotypes

The 62 genotypes of coriander were grouped into 10 distinct non-overlapping clusters.The highest number of genotypes (24) were found in cluster I persued by cluster III (13), cluster II (9), cluster IV (6), cluster X (5) and cluster V (1), cluster VI (1), cluster VII (1),cluster VIII (1) and cluster IX (1). The pattern of genotype distribution among various clusters also resulted in there is no geographical parallelism in the genotype grouping, denoting that genotypes of various geographical origins may be grouped along or vice-versa. Similar findings have been also reported by Patel *et al*. (2000), Singh *etal*. (2005), Mangesha *et al*. (2011) and Singh *et al*. (2018).

3.2 Intra and Intercluster Distance Average

Estimation of intra and inter-cluster distance for ten clusters has been given in Table 3. Cluster X (94.18) were observed as a maximum intra-cluster distance pursued by cluster IV (74.26), cluster III (67.45), cluster II (64.43), cluster I (35.72), cluster IV (0.00), cluster V (0.00), cluster VI (0.00), cluster VII (0.00), cluster VIII (0.00) haveto consist lowest intra-cluster distance.

Inter-cluster distance maximum value found between cluster IV with cluster X (575.40) were pursued by cluster VII with cluster X (429.75), cluster II with cluster X (345.80), cluster I with cluster X (225.55), cluster VII with cluster X (198.80), cluster III with cluster X (193.34.), cluster VI with

cluster X (128.73.), cluster IX with cluster X (85.59.) and cluster V with cluster X (78.52), The minimum inter-cluster distance was found between cluster V and cluster VI (29.01) followed by cluster V and cluster IX (30.64). Lower inter-cluster values between the clusters mean that the genotypes of the cluster were not significantly genetically different from one another, but higher inter-cluster distances indicated greater genetic divergence between the genotypes of those clusters. Some findings were also found by Patel *et al*. (2000), Singh *etal*. (2005), Mangesha *et al*. (2011) and Singh *et al*. (2018).

3.3 Cluster Means

The cluster means for various traits denoted that there were considerable differences between the clusters as shown in Table 4.

The highest cluster mean for days to 50% flowering was found inthe case of cluster VII (92.20) andthe lowest cluster mean for days to 50% flowering was recorded inthe case of cluster VIII (84.60).The highest cluster mean for plant height was found inthe case of cluster X (134.78) andthe lowest cluster mean for plant height was recorded inthe case of cluster IV (112.37). The highest cluster mean foranumber of nodes per plant was found inthe case of cluster IX (13.60) andthe lowest cluster mean fora number of nodes per plant was recorded inthe case of cluster IV (5.66). The highest cluster mean for number of branches per plant was found inthe case of cluster VI (8.40) andthe lowest cluster mean fora branches per plant was recorded inthe case of cluster VIII (6.40). The highest cluster mean for umbels per plant was found inthe case of cluster VII (35.40) andthe lowest cluster mean for umbels per plant was recorded inthe case of cluster III (25.32). The highest cluster mean for umbellates per umbel was found inthe case of cluster IX (7.80) andthe lowest cluster mean for umbellates per umbel was recorded inthe case of cluster V (6.40).

The highest cluster mean for fruits per umbellate was recorded in case of cluster IX (9.80) followed by cluster X (7.90). The highest cluster mean for fruits per umbel was found in case of cluster VII (40.00).

The highest cluster mean for umbel diameter was found inthe case of cluster VI (5.80). The highest cluster mean for 1000 seed weight was recorded inthe case of cluster V (11.75) andthe lowest cluster mean for 1000 seed weight was recorded inthe case of cluster IX. The highest cluster mean for seed yield per plant was recorded inthe case of cluster VII (14.00) followed by cluster VI (13.46) andthe lowest cluster mean for seed yield per plant was recorded inthe case of cluster III (8.72) followed by cluster IV (9.73). Similar findings have been also reported by Patel *et al*. (2000), Singh *etal*. (2005), Mangesha *et al*. (2011) and Singh *et al*. (2018).

3.4 Percent Contribution to Genetic Divergence in Coriander

The highest per cent contribution in genetic divergence in coriander was recorded by plant height (53.52%) followed by umbels per plant (22.16%), fruits per umbel (15.02%) and days to 50% flowering (7.88%).The other five contributions were by nodes per plant (0.69%), seed yield per plant (0.53%) and fruits per umbellates (0.11%). Based on estimates branches per plant and 1000 seed weight per cent was found to contribute negligible. There wereno contributions by umbel diameter, umbellates per umbel. The results for some of the traits also found by Patel *et al*. (2000),Singh *etal*. (2005),Mangesha et al. (2011) and Singh et al. (2018).

Table 2. Clustering pattern of 62 genotypes of corinader

Cluster Number	Number of genotypes	Genotypes
I	**24**	NDCor-1, NDCor-2, NDCor-3, NDCor-4, NDCor-9, NDCor-13, NDCor-14, NDCor-19, NDCor-21, NDCor-22, NDCor-25, NDCor-26, NDCor-29, NDCor-31, NDCor-32, NDCor-37, NDCor-38, NDCor-42, NDCor-46, NDCor-49, NDCor-50, NDCor-58, Hisar Anand, NDCor-2
II	**9**	NDCor-7, NDCor-8, NDCor-16, NDCor-17, NDCor-18, NDCor-20, NDCor-30, NDCor-33, NDCor-41
III	**13**	NDCor-36, NDCor-39, NDCor-40, NDCor-43, NDCor-45, NDCor-47, NDCor-48, NDCor-51, NDCor-52, NDCor-53, NDCor-54, NDCor-56, NDCor-59
IV	**6**	NDCor-5, NDCor-10, NDCor-11, NDCor-12, NDCor-15, NDCor-34
V	**1**	NDCor-55
VI	**1**	NDCor-24
VII	**1**	NDCor-23
VIII	**1**	NDCor-28
IX	**1**	NDCor-60
X	**5**	NDCor-6, NDCor-27, NDCor-35, NDCor-44, NDCor-57

Table 3. Inter and Intra cluster D2 value for 10 cluster in coriander

Clusters	I Cluster	II Cluster	III Cluster	IV Cluster	V Cluster	VI Cluster	VII Cluster	VIII Cluster	IX Cluster	X Cluster
I Cluster	**35.72**	96.28	112.57	165.62	82.75	74.51	75.88	121.55	106.34	225.55
II Cluster		**64.43**	140.73	125.12	191.54	144.01	138.03	99.24	199.15	345.80
III Cluster			**67.45**	232.52	118.47	151.75	247.62	144.10	134.26	193.34
IV Cluster				**74.26**	353.89	316.33	140.79	260.67	361.38	575.40
V Cluster					**0.00**	29.01	200.27	106.37	30.64	78.52
VI Cluster						**0.00**	164.11	58.15	40.82	128.73
VII Cluster							**0.00**	231.45	252.15	429.75
VIII Cluster								**0.00**	74.99	198.80
IX Cluster									**0.00**	85.59
X Cluster										**94.18**

Table 4. Intra Clusters group means for 10 characters in Coriander

	Days to 50% flowering	Plant height (cm)	Nodes per plant	Branches per plant	Umbels per plant	Umbellates per umbel	Fruits per Umbellate	Fruits per umbel	Umbel diameter (cm)	1000 seed weight (g)	Seed yield per plant (g)
I Cluster	90.22	122.17	12.75	7.23	31.61	7.22	7.38	38.63	5.37	10.70	11.98
II Cluster	88.78	118.96	12.68	6.81	30.60	6.89	6.60	32.82	5.10	10.94	10.46
III Cluster	88.66	124.74	11.89	6.91	25.32	6.77	7.08	36.72	4.98	10.23	8.72
IV Cluster	87.92	112.37	11.67	6.73	29.25	6.90	7.35	36.83	5.13	9.75	9.73
V Cluster	88.00	129.62	11.80	6.80	31.20	6.40	7.20	39.00	4.88	11.75	13.29
VI Cluster	87.70	127.76	13.00	8.40	34.40	6.80	6.40	36.00	5.80	11.01	13.46
VII Cluster	92.20	117.00	10.20	6.80	35.40	6.40	6.80	40.00	5.64	10.79	14.00
VIII Cluster	84.60	125.40	12.20	6.40	33.20	7.20	7.80	31.20	4.76	10.54	10.23
IX Cluster	85.60	129.74	13.60	6.60	32.40	7.80	9.80	38.00	5.52	9.63	10.94
X Cluster	88.24	134.78	12.78	6.88	29.36	7.00	7.90	37.84	4.93	10.56	10.81

Table 5:- Per cent contribution of different traits in genetic divergence in coriander.

S. No.	Source	Contribution (%)
1.	**Days to 50% flowering**	7.88%
2.	**Plant height (cm)**	53.52%
3.	**Nodes/plant**	0.69%
4.	**Branches/ plant**	0.05%
5.	**Umbels/plant**	22.16%
6.	**Umbellates/ umbel**	0.00%
7.	**Fruits/ umbellate**	0.11%
8.	**Fruits/umbel**	15.02%
9.	**Umbel diameter (cm)**	0.00%
10.	**1000 seed weight (g)**	0.05%
11.	**Seed yield/ plant (g)**	0.53%

4. CONCLUSION

Inthe presentinvestigation with the help of results specific conclusionsare drawn. There exists ample variation within the germplasm of coriander. Maximum inter-cluster distance was observed between cluster IV with cluster X (575.40). Crossing among genotypes of cluster VII with cluster X may give riseto desirable F1/segregates in future.

COMPETING INTERESTS

Author have decleared that no competing intrests exist.

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