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Studies on Genetic Divergence Analysis of Coriander Germplasm (*Coriandrum sativum* L.)

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ABSTRACT: The present investigation was conducted with 60 genotypes including three checks (NDCor-1, NDCor-2 and Hisar Anand) in Augmented Block Design in 4 blocks (15 genotypes + 3 checks in each block). On the basis of 12 characters, the non-hierarchical Euclidean cluster analysis was used to examine the genetic divergence across 60 coriander germplasm collections. The 63 coriander genotypes were divided into 7 groups. The intra-cluster group means for 12 characters varied significantly amongst the various clusters. Therefore, crosses between members of clusters which are having high cluster means for important characters coupled with high inter-cluster distances between them, are likely to be more useful. Cluster VI, followed by cluster I, had the highest cluster mean for seed yield per plant, whereas cluster VI, followed by cluster VI, had the lowest cluster mean for seed yield per plant. Crosses between cluster members who are far apart from one another are likely to result in segregates that are desirable. In this situation, cluster III recorded the most intra-cluster distance, whereas clusters II and VII recorded the greatest inter-cluster distance, and cluster V recorded the greatest number of genotypes.

Keywords: Cluster, Divergence, Genotypes, Segregates.

INTRODUCTION

Coriander originated in Mediterranean region and is cultivated largely in India and is appreciably grown in Andhra Pradesh, Tamil Nadu, Karnataka, Punjab, Rajasthan, M.P. and UP. Rajasthan is the main growing state and contributes about 40 per cent production in India. The states Rajasthan and Gujarat have emerged as "Seed Spices Bowl". In India, with a yearly production of 822 million tons and an average productivity of 1.306 million tonnes/ha, it covers an area of 629 thousand hectares (National Horticulture Board, 2020–2021). The smooth, erect annual herb *Coriandrum sativum* L. grows to a height of 90–100 cm, with a long tap root, and a 300–700mm thin, branched leafy stem. The flowers are tiny and actinomorphic; in compound terminal umbels, the periphery flowers are zygomorphic, hermaphrodite or occasionally unisexual, and white or pink in color. There are two free carpels, an epigynous ovary, five petals, five stamens, five sepals. Schizocarpic fruits are spherical, yellowish brown, and may or may not have pedicels (of any length). Each mericarp has four, straight, primary ridges and five secondary ridges. Seeds are aromatic having a pleasant aromatic taste and a slight fragrant odour and are about 3.0 mm in diameter. The dried ground fruits are the major ingredient of curry products.

Coriander seeds are used to extract high-quality oleoresin, and coriander oil is a useful component in perfumes. The flavoring agent oleoresin is used to flavor drinks, pickles, and desserts. Coriander is a good source of phenolics and flavonoids content (Choudhary *et al*., 2017). About 18–21% of the fatty acids in the seeds are used in cosmetics. Coriander is used to flavor liquor, especially gin. It is advised to use *C. sativum* either on its own or in combination with other herbal remedies to treat anxiety, convulsions, sleeplessness, and dyspeptic problems. Additionally, it has been demonstrated to enhance blood glucose regulation, making it a prospective candidate for use as an antihyperglycemic drug (Mandal *et al.*, 2015).

A quantitative assessment of genetic diversity guide the breeder for quick breeding program advancement. The likelihood of acquiring a higher level of heterotic expression in F_1 and a wide range of variability in segregating generations increases with parental diversity within the overall limit of fitness (Kalidasu *et al.*, 2015). The degree of genetic variety in the germplasm for various traits, which are influenced by environmental influences, must thus be evaluated.

MATERIALS AND METHODS

The Main Experimental Station, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) was the site of the experiment, 60 coriander varieties along with three check varieties *viz*. Hisar Anand, NDCor-1, and NDCor-2were used—that were sown during *Rabi* 2020–21. It is located 113 m above mean sea level between 24.47° and 26.54°N latitude and 81.84° and 83.58°E longitude. The experimental plot consisted of 120 plants at 30 cm × 15 cm spacing. All the recommended package of practices were adopted for raising a successful and healthy crop. Five plants were picked at random from each replication and each treatment and given tags so they could be observed. Periodically, observations were recorded on days to 50% flowering, plant height (cm), branches per plant, inter-nodal length, umbel diameter (cm), number of umbels per plant, number of umbellates per umbel, number of fruits per umbel, number of fruits per umbellate, days to maturity, 1000 seed weight (g), and seed yield per plant (g). Through non-hierarchical Euclidean cluster analysis, the genetic divergence of 63 genotypes, including checks planted in an Augmented Block Design, was investigated (Beale, 1969; Spark, 1973). The statistical analysis was done by using the techniques of analysis of "Augmented Block Design". These designs were developed by Federer (1956). Utilizing R-STUDIO software, both analyses were computed.

RESULTS AND DISCUSSION

On the basis of 12 characters, the non-hierarchical Euclidean cluster analysis was used to examine the genetic divergence across 63 coriander germplasm collections. The pseudo F-test showed that clustering the 63 genotypes was best accomplished by cluster configurations. Therefore, it was anticipated that the 63 genotypes would be divided into 7 distinct groups. Table 1 shows the arrangement of 63 coriander germplasm samples into 7 clusters. The highest number of genotypes was presented in cluster V, which contained 22 genotypes followed by cluster III contain 12 genotypes and cluster IV VI both contains 9 genotypes cluster VII, II, and I possessed 6, 3, and 2, genotypes respectively. An examination of the estimate of within and between cluster genetic diversity presented by intra and inter cluster D^2 values revealed that genotypes of the same cluster had little divergence from each other with respect to aggregate effect of 12 character under study Table 1.

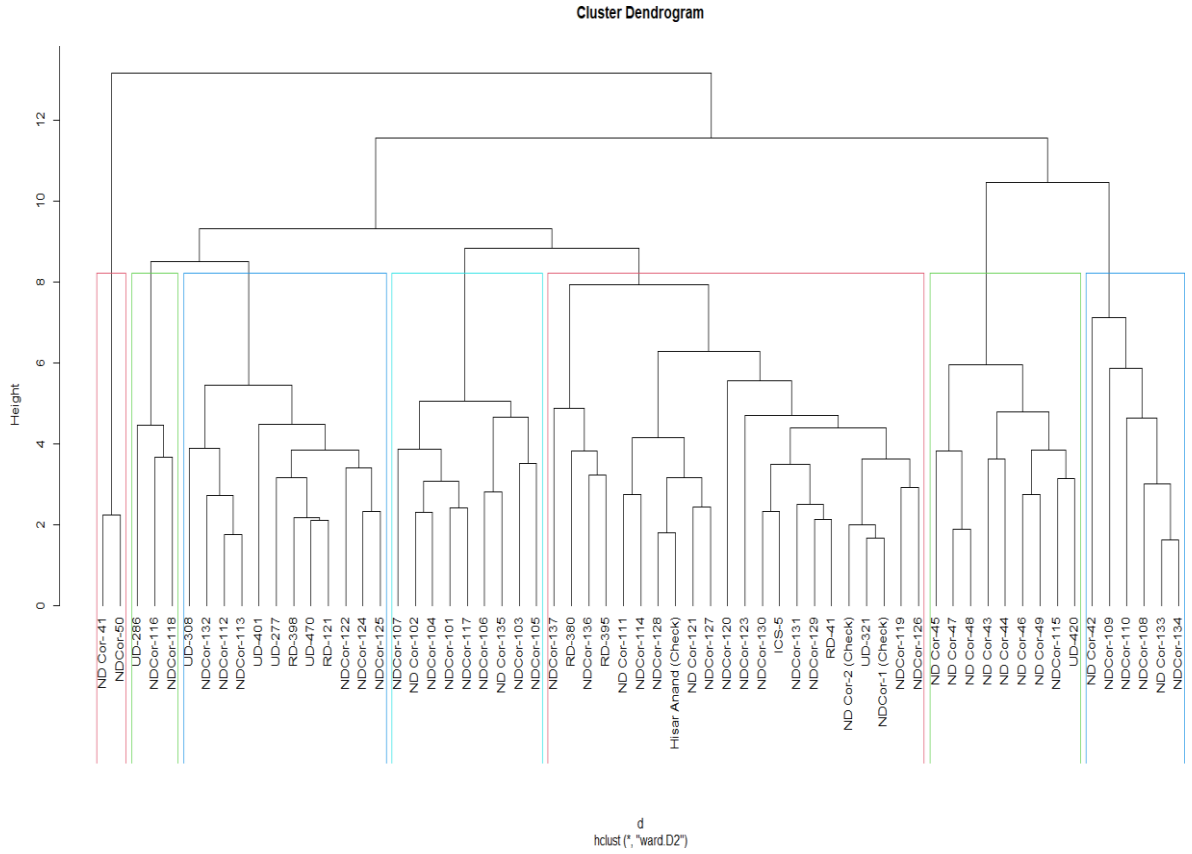

Fig. 1. Relationship between 63 coriender genotypes in 7 clusters as shown by a dendogram.

Table 1: Clustering pattern of 63 coriander genotypes on the basis of Non-hierarchical Euclidean Cluster analysis for 12 characters.

Cluster Number	Number of genotypes	Genotypes
I	2	NDCor-41, NDCor-50
II	3	UD-286, NDCor-16, NDCor18
III	12	UD-308, NDCor-132, NDCor-112, NDCor-113, UD-401, UD-277, RD-398, UD-470, RD- 121, NDCor-122, NDCor-124, NDCor-125
IV	9	NDCor-107, NDCor-102, NDCor-104, NDCor-101, NDCor-117, NDCor-106, NDCor- 135, NDCor-103, NDCor-105
V	22	NDCor-137, RD-380, NDCor-136, RD-395, NDCor-111, NDCor-114, NDCor128, Hisar Anand, NDCor-121 NDCor-127, NDCor-120, NDCor-123, NDCor-130, ICS-5, NDCor-131, NDCor-129, RD- 41, NDCor-102, UD-321, NDCor-1, NDCor-119, NDCor-126
VI	9	NDCor-45, NDCor-47, NDCor-48, NDCor-43, NDCor-44, NDCor-46, NDCor-49, NDCor- 115, UD-420
VII	6	NDCor-42, NDCor-109, NDCor-110, NDCor-108, NDCor-113, NDCor-134

Table 2: Estimates of average intra and inter cluster distance for 7 clusters in coriander.

Clusters	I	II	III	IV	V	VI	VII
I	**23.99**	66.36	44.80	47.31	53.55	40.88	62.28
II		**43.32**	68.29	65.02	55.94	85.26	139.53
III			**46.40**	57.60	51.19	66.23	101.54
IV				**23.17**	44.80	47.73	66.70
V					**30.05**	48.71	72.93
VI						**19.84**	49.12
VII							**5.06**

Cluster III had the maximum intra-cluster distance (46.40), followed by clusters II (43.32), cluster V (30.05), and cluster I (23.99), while clusters VI (19.84) and cluster VII (5.06) had the minimum intra-cluster distances. The maximum inter-cluster distance was found between cluster II and VII (139.53), followed by cluster III and VII (101.54), cluster II and VI (85.26), cluster V and VII (72.93), cluster II and III (68.28), cluster IV and VIII (66.7), cluster I and II (66.36), cluster III and VI (66.23), cluster III and IV (57.60), cluster II and V (55.94), cluster I and V (53.55), cluster III and V (51.19), cluster VI and VII (49.12) also exhibited high inter cluster distances. The minimum inter-cluster distance was found between cluster V and VI (48.71), Cluster IV and VI (47.73), Cluster I and III and Cluster IV and V (44.80) respectively. In general, the results showed that the clusters with higher inter-cluster D^2 value estimations were a distance than the clusters with low value. These results are in close confirmation with the findings of Gauhar *et al*. (2018); Acharya *et al.* (2021).

A data showed that the cluster means for the various characters under consideration exhibited significant variances for all the characters between them. Table 3 displays the cluster means for the twelve characters in coriander. Cluster VI had the highest cluster mean for days to 50% flowering (98.00), which was followed by cluster III (94.69). Cluster V had the lowest cluster mean for days to 50% flowering, followed by cluster VII (88.25).

Cluster V had the highest cluster mean for plant height (147.96), which was followed by cluster III (138.33). Cluster VI (124.56) had the lowest cluster mean for plant height, followed by cluster II (125.77). Cluster VI (6.87) had the highest cluster mean for the number of branches per plant, which was followed by cluster II (6.04). Cluster V had the lowest cluster mean for branches per plant (4.33), which was followed by cluster III (4.51). Cluster VI had the maximum cluster mean for the number of inter-nodal lengths (14.60), followed by cluster VII (12.94). Cluster IV had the lowest cluster mean for inter-nodal length (10.47), which was followed by cluster I (10.80). Cluster VII (12.94) had the greatest cluster mean for umbel diameter, followed by cluster VI (7.84). Cluster I (5.44) reported the lowest cluster mean for umbel diameter, followed by II (5.55). These results are in close confirmation with the findings of (Chauhan *et al*., 2019).

Cluster VI had the highest cluster mean for umbels per plant (59.78), which was followed by cluster III (50.88). Cluster VII had the lowest average number of umbels per plant (7.05), followed by cluster VIII (41.14). Cluster VI (8.49) had the higher cluster mean for umbellets per umbel, which was followed by cluster II (7.13). Cluster IV had the lowest cluster mean for umbellets per umbel (6.17) while cluster I had the highest (6.34). Cluster VI had the highest cluster mean for the quantity of fruits per umbel (51.80), which was followed by cluster IV (42.72). The number of fruits per umbel at the lowest cluster mean was noted in case of cluster II (28.95) followed by cluster III (30.07). Cluster VI (10.82), followed by Cluster VII (10.16), reported the highest cluster mean for the number of fruits per umbellate. Cluster I (7.00) and Cluster II (7.03) had the lowest cluster means for the number of fruits per umbellate. Cluster VI (12.80) had the highest cluster mean for test weight (g), which was followed by cluster I (11.40). Cluster VIII (9.51) had the lowest cluster mean for test weight (g), which was followed by cluster (9.66).

Table 3: Estimates of average cluster means for 12 characters in coriander.

Cluster	Days to 50% of flowering	Plan t height (cm)	Branches/plant	Internodal length (cm)	Umbel diameter (cm)	Number of umbels/ plant	Number of umbellates/umbel	Number of fruits /umbel	Number of fruits/umbellate	Days to maturity	1000 seed weigh t (g)	Seed yield/pl ant
I	93.19	138.33	4.99	10.80	5.44	41.99	6.34	33.62	7.00	146.77	11.40	9.60
II	94.00	125.77	6.04	11.78	5.55	41.14	7.13	28.95	7.03	154.82	10.89	6.81
III	94.69	141.12	4.51	11.41	6.39	50.88	6.51	30.07	7.05	156.46	10.78	10.91
IV	91.80	115.15	5.74	10.47	5.87	48.25	6.17	42.72	6.20	154.90	9.66	12.82
V	87.60	147.96	4.33	12.10	5.96	44.89	6.94	33.68	6.94	151.95	10.87	9.49
VI	98.00	124.56	6.87	14.60	7.84	59.78	8.49	51.80	10.82	153.50	12.80	13.32
VII	88.25	132.65	5.45	12.94	12.94	7.05	7.05	33.45	10.16	150.00	9.51	8.98

The highest cluster mean for days to maturity was observed in case of cluster III (156.46) followed by Cluster II (154.90). Cluster I had the lowest cluster mean for days to maturity (146.77), followed by cluster V (151.93). Cluster VI had the highest cluster mean for seed yield per plant (13.32), which was followed by cluster IV (12.82). Cluster II (6.81) and Cluster I (9.60) had the lowest cluster means for seed yield per plant, respectively. Similar findings were reported by Singh *et al.* (2005); Meena *et al.* (2018).

CONCLUSIONS

The present study grouped the 63 coriander genotypes into 7 diverse clusters and delineated few important traits contributing towards total variability crosses between members of clusters which are having high cluster means for important characters coupled with high inter cluster distances between them, are likely to be more useful. This could be the basis for planning an effective hybridization programme and selection of genotypes for further coriander improvement programme.

FUTURE SCOPE

The present experiment would help in creating a base line for future work. Selection of parents from these diverse clusters for hybridization programme would help in achieving novel recombinants.

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Conflicts of Interest. None.

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