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ASSESSMENT OF GENETIC VARIABILITY PARAMETERS IN CORIANDER (*CORIANDRUM SATIVUM* L.) GENOTYPES FOR GROWTH, FOLIAGE YIELD AND QUALITY TRAITS

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Abstract

The present study was conducted to know extent of genetic variability, heritability and the genetic advance in thirty coriander genotypes in the year 2018-19 at the vegetable science department, Kittur Rani Chennamma College of Horticuluture, Arabhavi, Gokak, Karnataka, India. The experiment was laid out in randomized complete block design with two replications. Observations were recorded on the twenty growth, earliness, yield and quality traits. The experiment revealed that good amount of variability is present in coriander collection and most of the characters have high GCV, PCV, heritability and GAM except plant height, petiole length and root length at 50 DAS. Therefore, greater emphasis should be given on these characters while selecting for higher foliage yield and yield related traits.

Key words : Coriander, variability, heritability, genetic advance, olericulture.

Introduction

Coriander (*Coriandrum sativum* L.) is an annual herb mostly grown for its leaves and seed fruit as spice and condiment. It is an important member of Umbelliferae family having 2n=22 chromosomes and mostly considered native to Mediterranean and near eastern region (Bhandari and Gupta, 1993). It is cultivated throughout the world for its aromatic leaves and spicy seed due to its wide adaptation to range of eco-geographic conditions (Purseglove *et al.*, 1981; Simon 1990; Arif *et al.*, 2014). It is broadly cultivated in North Africa, Europe, India, China and Thailand. The main exporters of coriander are the Ukraine, Russia, India and Morocco and the main importers are the USA, Sri Lanka and Japan.

India is known for its rich traditional food and its diversity. The stems, leaves and fruits of coriander have a pleasant aroma, which makes them used for flavoring continental curries and soups. The fruits are extensively employed as a condiment in the preparation of curry powder, pickling, spices, sausages and seasoning and are also used to flavour pastry, biscuits, buns cakes and liquors,

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particularly gin (Gauhar *et al.*, 2018). Recent understanding of the neutraceutical and medicinal properties of the leaves elevated the status of this crop for foliage purpose. In spite of all this, there are no commercial varieties of coriander so far developed only for foliage purpose.

Critical assessment of the nature and magnitude of variability of germplasm is a prerequisite for any efficient breeding programme and it provides an opportunity to identify the superior lines with desirable yield and quality traits, which further enables to develop a high yielding variety. There are two kinds of variability in crop plants, genetic and non genetic. The non genetic variability is the result of genetic and environmental interactions which is however, not of much use to breeders, since it cannot be perpetuated from generation to generation. Heritability (h^2) estimate provides the information regarding the amount of transmissible genetic variation to total variation and determines genetic improvement and response to selection whereas improvement in the mean genotypic value of selected plants over the parental population is known as genetic advance. The estimate of genetic advance as percentage of mean (GAM) provides more reliable information regarding the effectiveness of selection in improving a trait (Rekha, 2018). Keeping all these things in view, the present investigation was made to explore the genetic variability, by determining the magnitude of genetic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability estimates (h^2) and genetic advance as percentage of mean (GAM) of different traits effects in thirty coriander genotypes.

Materials and Methods

The experimental material comprised of thirty genotypes of coriander, collected from different places of India with majority from horticulture research and extension center, Devihosur, Haveri and were sown during *Rabi*, 2019. The details of the coriander genotypes used in the present experiment are presented in the (Table 1). The experiment was laid out in randomized complete block design with two replications at the vegetable science department, Kittur Rani Chennamma College of Horticuluture, Arabhavi, Gokak, Karnataka. College is located in Arabhavi village which comes under the northern dry zone of Karnataka state at 16° 15' N latitude, 74° 45' E longitude and at an altitude of 612.03 meters above the mean sea level.

The seeds were sown with the spacing of 22.50 cm × 5.00 cm. Before sowing, the seeds of coriander were splited into two parts by rubbing on floor. Then required quantity of seed of different coriander genotypes were treated with thiram @ 2gm/kg of seeds. Treated seeds were dried in shade for 30 minutes. Sowing was done in a line at a row spacing of 22.5 cm and at a depth of 1-2 cm. Recommended dose of fertilizer was applied (35:35:35 NPK kg/ha) and other agronomical practices were practiced as per the package of practices given by UHS, Bagalkot for healthy crop growth (Anon., 2014).

In each replication, five plants were selected randomly and marked for observation at 50 days after sowing (DAS). Observations were recorded for twenty different characters *viz.*, plant height (cm), number of branches, stem base diameter (cm), number of leaves per plant, leaf area (cm^2) at 45 DAS, petiole length (cm), root length (cm), root weight (g), fresh and dry weight of the plant (g), fresh and dry weight of the leaf and stem, leaf to stem ratio, foliage yield per plant (g), foliage yield (kg/plot), chlorophyll content of the leaves (mg/g), vitamin C (mg/100gm)and protein content (mg/g). For the estimation of chlorophyll (Shoaf and Lium 1976), vitamin C (Tauber and Kleiner, 1934) and protein content (Lowery, 1951) following methodology was used.

Estimation of chlorophyll content of leaves (mg/g)

Chlorophyll content of leaf was analyzed by collecting the matured leaves from of the plants and was cut into small pieces. Known weight of sample (100 mg) was incubated in 7.0 ml DMSO at 65^0C for 60 minutes. After the incubation, supernatant was collected by decanting. Then the volume of supernatant was made up to 10 ml using DMSO. The absorbance of extract was measured at 645 nm and 663 nm using DMSO as a blank in spectrophotometer. Total chlorophyll content was calculated by using the following formula.

mg chlorophyll 'a'/ g tissue =

$$[12.7\ (A_{663}) - (2.69\ X\ A_{645})]\ \frac{V}{1000}\ X\ W$$

mg chlorophyll 'b'/ g tissue =

$$[22.9\ (A_{645}) - (4.68\ A_{663})]\frac{V}{1000}\ X\ W$$

mg total chlorophylll/g tissue =

$$[20.2\ (A_{645}) + (8.02\ A_{663})]\frac{V}{1000}\ X\ W\ X\ a$$

A = Absorbance at specific wavelengths 645 nm and 663 nm, V = Volume of the extract (10 ml), W = Fresh weight of the sample (100 mg), a = Path of light in cuvette (1 cm).

2. Estimation of vitamin C (mg/100g)

Ascorbic acid content was estimated by using 2, 6,-dichlorophenol indophenols dye by volumetric method. Two grams of sample was macerated with 4 per cent oxalic acid and was filtered by using muslin cloth to get a clear aliquot. Five milliliters of aliquot was titrated against 2,6,- dichlorophenol indolephenols dye till the pink end point which persisted for at least 15 seconds (V_2) and (V_1) is add 10 ml of 4% oxalic acid and titrate against the dye. Ascorbic acid was estimated using the formula given below and expressed per 100 g of edible part (Tauber and Kleiner, 1934).

Amount of ascorbic acid mg/100 g sample =

$$\frac{0.5\,\text{mg}}{V_1} \times \frac{V_1}{5\,\text{ml}} \times \frac{100\,\text{ml}}{\text{Wt of the sample}} \times 100$$

Estimation of protein content (mg/g)

Stock standard solution: 50 mg of Bovine Serum albumin (BSA) was dissolved in distilled water and made up to 50 ml with distilled water in a volumetric flask. This solution contained 1 mg of protein per ml.

Folin-Ciocalteau reagent (1 N): Commercially available FCR (2N) was diluted suitably to get 1N FCR with distilled water.

Procedure: Pipette out 0.2, 0.4, 0.6, 0.8 and 1.0 ml of the working standard solution into series of test tubes. Pipette 0.1 ml and 0.2 ml of the sample extract into two other test tubes. Volume made upto 1 ml with water in all the tubes. A tube with 1 ml water serves as blank. Added 5 ml of solution C mixed well and incubated at room temperature in dark for 30 min. Read the absorbance at 660 nm against the blank. Drawn a standard graph, calculated the amount of protein in the sample and expressed the results as mg/ g or mg/100 g sample or percentage.

The genotypic and phenotypic coefficient of variance, heritability, genetic advance and genetic advance over percent of mean were calculated from the mean data as per formula suggested by Burton and Devane (1953), Falconer (1981), Robinson *et al.* (1949) and Johnson *et al.*, (1955) respectively for all the parameters under study.

Results and Discussion

Analysis of variance revealed significant differences among genotypes for all the traits studied indicating presence of significant variability in the genotypes under study (Table 2). The range of variance was high for vitamin C (116.50-231.00 mg/100gm) followed by leaf area at 45 DAS (9.32-37.73) and number of leaves per plant (9.89-32.61) at 50 DAS.

Range values for variability alone are not reliable since, it includes genotypic, environment and genotypic x environment variations. Hence, estimates of GCV and PCV were carried out (Table 3 and Fig. 1). PCV was higher than the GCV for all the traits under study indicating that environmental factors were influencing their expression. PCV varied from root length (9.36) to dry stem weight (63.21) whereas GCV values ranged from 8.90-62.05 for the same traits. In the present investigation, high range of PCV and GCV was observed for almost all the traits except plant height, petiole length, fresh leaf and stem weight and leaf to stem ratio, which showed moderate PCV and GCV. Whereas, root length showed a low PCV and GCV. Selection for these traits showing

Table 1: List of coriander genotypes with source of collection used in the experiment.

Sl. No.	Genotype	Source
1.	DCC-21	HREC, Devihosuru, Haveri.
2.	DCC-22	HREC, Devihosuru, Haveri.
3.	DCC-23	HREC, Devihosuru, Haveri.
4.	DCC-24	HREC, Devihosuru, Haveri.
5.	DCC-25	HREC, Devihosuru, Haveri.
6.	DCC-26	HREC, Devihosuru, Haveri.
7.	DCC-27	HREC, Devihosuru, Haveri.
8.	DCC-28	HREC, Devihosuru, Haveri.
9.	DCC-29	HREC, Devihosuru, Haveri.
10.	DCC-30	HREC, Devihosuru, Haveri.
11.	DCC-31	HREC, Devihosuru, Haveri.
12.	DCC-32	HREC, Devihosuru, Haveri.
13.	DCC-33	HREC, Devihosuru, Haveri.
14.	DCC-34	HREC, Devihosuru, Haveri.
15.	DCC-35	HREC, Devihosuru, Haveri.
16.	DCC-36	HREC, Devihosuru, Haveri.
17.	DCC-37	HREC, Devihosuru, Haveri.
18.	DCC-38	HREC, Devihosuru, Haveri.
19.	DCC-39	HREC, Devihosuru, Haveri.
20.	DCC-40	HREC, Devihosuru, Haveri.
21.	DCC-41	HREC, Devihosuru, Haveri.
22.	DCC-42	HREC, Devihosuru, Haveri.
23.	DCC-43	HREC, Devihosuru, Haveri.
24.	DCC-44	HREC, Devihosuru, Haveri.
25.	DCC-45	HREC, Devihosuru, Haveri.
26.	DCC-46	HREC, Devihosuru, Haveri.
27.	DCC-81	HREC, Devihosuru, Haveri.
28.	HUB-1	Local collection from Coorg
29.	HUB-2	Local collection from Guntur
30.	DWD-3*	HREC, Devihosuru, Haveri.

*- Commercial Check.

Table 2: Analysis of variance (mean sum of squares) for growth, yield and quality parameters in coriander genotypes.

Sl. No.	Source of variation/Characters	Replications	Treatments (Genotypes)	Error
	Degrees of freedom	**2**	**30**	**29**
1.	Plant height (cm)	103.28	96.50**	17.76
2.	Number of branches per plant	3.39	14.44**	31.87
3.	Stem base diameter (cm)	0.02	0.36**	0.01
4.	Number of leaves per plant	2.71	85.21**	3.79
5.	Leaf area (cm^2) at 45 DAS	1.86	150.11**	9.26
6.	Petiole length (cm)	0.02	1.36**	0.31
7.	Root length (cm)	0.15	0.64**	0.03
8.	Root weight (g)	0.00	0.03**	0.00
9.	Fresh weight of the plant (g)	1.74	6.53**	0.17
10.	Dry weight of the plant (g)	0.16	6.27**	0.05
11.	Fresh leaf weight (g)	0.03	0.16**	0.01
12.	Fresh stem weight (g)	0.02	0.19**	0.02
13.	Dry leaf weight (g)	0.00	0.15**	0.00
14.	Dry stem weight (g)	0.00	0.06**	0.00
15.	Leaf to stem ratio	0.10	0.83**	0.25
16.	Foliage yield per plant (g)	1.74	6.53**	0.17
17.	Foliage yield (kg/plot)	1.11	4.18**	0.11
18.	Chlorophyll content in leaves (mg/g) at 45 DAS	0.02	0.26**	0.00
19.	Vitamin C (mg/100g)	11.01	1338.36**	42.20
20.	Protein content (mg/g)	0.01	0.49**	0.01

** Significance at 1% * Significance at 5% DAS- Days after sowing

high to moderate PCV and GCV could be given importance for improvement programme of coriander. Wide difference between PCV and GCV indicated their sensitiveness to environmental fluctuations, whereas narrow difference showed less environmental interference on the expression of these traits. The traits, which showed high variations with less difference between GCV and PCV are of economic importance and there is scope for improvement of these traits through selection. Similar findings were also reported earlier by Megeji and Korla (2002) for leaf yield, Nair *et al.*, (2012) for chlorophyll content, plant height and vegetative yield, Meena *et al.* (2013) for chlorophyll and leaf area, Dhakad *et al.*, (2017) for plant height and Rekha (2018) for almost all characters in coriander. Bhargava *et al.*, (2007), Panda *et al.*, (2017) for fresh weight of plant, leaf to stem ratio and foliage yield per plant; Kujur (2015) for dry matter per cent, plant height and no. of leaves per plant in various other leafy vegetables.

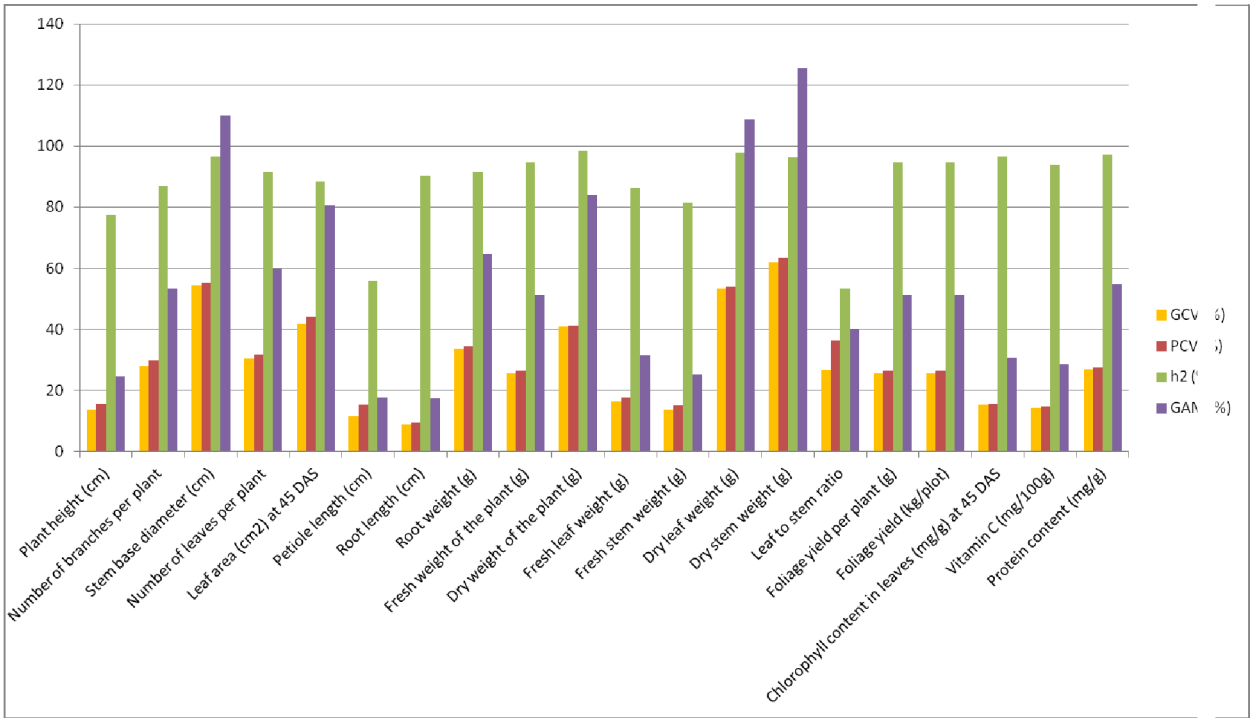

Fig. 1: Variability parameters for different growth, yield and quality traits.

Table 3: Estimates of genetic variability for growth, yield and quality parameters in coriander genotypes.

Sl. No.	Character	Mean	Range	GV	PV	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
1.	Plant height (cm)	47.85	33.77-66.86	42.06	54.44	13.55	15.42	77.26	11.74	24.54
2.	Number of branches per plant	9.29	4.67-15.20	6.71	7.73	27.86	29.91	86.75	4.97	53.45
3.	Stem base diameter (cm)	0.77	0.10-1.52	0.18	0.18	54.36	55.31	96.58	0.85	110.05
4.	Number of leaves per plant	20.97	9.89- 32.61	40.69	44.52	30.41	31.82	91.38	12.56	59.89
5.	Leaf area (cm^2) at 45 DAS	20.17	9.32-37.73	70.42	79.68	41.61	44.26	88.38	16.25	80.58
6.	Petiole length (cm)	5.78	4.42-7.89	0.44	0.79	11.51	15.40	55.87	1.02	17.73
7.	Root length (cm)	6.23	5.33-7.42	0.31	0.34	8.90	9.36	90.44	1.08	17.45
8.	Root weight (g)	0.34	0.11-0.52	0.01	0.01	33.60	34.41	91.36	0.22	64.75
9.	Fresh weight of the plant (g)	6.97	3.90-10.64	3.17	3.35	25.57	26.27	94.72	3.57	51.32
10.	Dry weight of the plant (g)	4.30	1.40-7.73	3.11	3.16	41.00	41.32	98.42	3.60	83.77
11.	Fresh leaf weight (g)	1.68	1.22-2.25	0.08	0.09	16.42	17.67	86.24	0.53	31.40
12.	Fresh stem weight (g)	2.11	1.55-2.63	0.08	0.10	13.65	15.13	81.43	0.54	25.38
13.	Dry leaf weight (g)	0.52	0.07-1.07	0.08	0.08	53.36	53.93	97.93	0.56	108.78
14.	Dry stem weight (g)	0.28	0.03-0.80	0.03	0.03	62.05	63.21	96.34	0.35	125.46
15.	Leaf to stem ratio	2.02	0.62-3.47	0.29	0.54	26.64	36.45	53.41	0.81	40.11
16.	Foliage yield per plant (g)	6.97	3.90-10.64	3.17	3.35	25.57	26.27	94.72	3.57	51.32
17	Foliage yield (kg/plot)	5.58	3.12-8.51	2.03	2.14	25.57	26.27	94.72	2.86	51.32
18.	Chlorophyll content in leaves (mg/g) at 45 DAS	2.38	1.31-3.04	0.13	0.13	15.15	15.42	96.54	0.73	30.66

GV- Genotypic variance PV- Phenotypic variance GCV- Genotypic co-efficient of variation
PCV- Phenotypic co-efficient of variation h^2 - Heritability (broad sense) GA- Genetic advance
GAM- Genetic advance (per cent of mean)

The effectiveness of selection for any character depends not only on the amount of phenotypic and genotypic variability, but also on estimates of broad sense heritability. High heritability was found for all the characters under experiment except petiole length at 50 DAS. Similar results were also obtained by Nair *et al.,* (2012) and Rekha (2018) in coriander whereas Shukla *et al.,* (2006), Panda *et al.,* (2017) for leaf area, fresh weight of the plant, dry weight of the plant and foliage yield per plant in amaranth and Kujur (2015) and Basavaraj (2018) in bathua. The information on heritability alone may be misleading, when used in combination with genetic advance, the utility of heritability estimate increases. To facilitate the comparison of progress in various characters of different genotypes, genetic advance was calculated as percentage of mean. High GAM was shown by all the characters under study except petiole length and root length. In the present investigation, the very high estimates of heritability coupled with high values of GAM were observed for most of the characters. Similar results were also reported by Nair *et al.,* (2012), Ameta *et al.,* (2016), Farooq *et al.,* (2017) and Rekha (2018) in coriander. Shukla *et al.,* (2006), Panda *et al.,* (2017) in amaranth for leaf area and foliage yield/plant. Santosha (2012) for fresh weight and dry weight of the plant in fenugreek. Kujur (2015), Basavaraj (2018) in bathua for fresh weight of the plant, dry weight of the plant, leaf area and foliage yield/plant. Rest of the traits showed moderate to low heritability estimates coupled with moderate to GAM indicated the role of non additive genetic variance in their expression and there can be little response to selection and these traits can be exploited through heterosis breeding.

In conclusion, the experiment revealed that almost all the characters except plant height, petiole length and root length in coriander genotypes recorded high GCV, PCV, heritability and GAM, which suggests that these characters showed lot of variability with additive gene action. Therefore, these characters could be improved by simple selection for yield improvement in coriander.

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