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Evaluation of coriander (*Coriandrum sativum* L) genotypes for growth and herbage yield in the northern transitional zone of Karnataka

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Abstract
Coriander is mainly used as condiment in the preparation of curry powder, pickles, sausages, seasonings, chutney and salads etc. There is great potential for commercial production of coriander under transitional zone but there is no systematic study on the performance of different genotypes. Hence the present investigation for identification of high yielding genotypes for a particular agro-climatic region has been undertaken. A field experimentation was laid out at Horticulture Research Station, Devihosur, Haveri District, Karnataka, in Randomized Complete Block Design (RCBD) for sixty one Devihosuru Coriander Collections (DCC) -1 to DCC-61 including DWR-1 and Ajjampura in two replication. Observation on various growth and herbage yield related parameters viz Plant height (cm), Number of primary branches, Number of secondary branches, Number of leaves, Fresh weight of the plant (g) Dry weight of the plant (g), Herbage yield (g), Days to 50% flowering, Number of umbels per plant, Number of umbellets per umbel, Number of seeds per umbellet, 1000 seed weight (g), Seed yield per plant (g), Days to maturity, Harvest index (%). were recorded. The analysis of variance revealed highly significant difference among genotypes for twenty eight characters. The phenotypic coefficient of variation was more than genotypic coefficient of variation for all the characters studied. High heritability coupled with high genetic advance as per cent of mean was observed for characters like plant height, number of primary branches, number of secondary branches, number of leaves, fresh weight of the plant, dry weight of the plant at harvest, number of umbels per plant, number of umbellets per umbel, thousand seed weight, number of seeds per umbellet, seed yield per plant. The present investigation also identified DCC 28, DCC 38, DCC 42, DCC 47, DCC 57 and DCC 5 as a promising genotypes for both herbage and seed yield under transitional zone of Karnataka.

Keywords: coriander, genotypes, heritability, herbage yield, coriander seeds

Introduction
Coriander (*Coriandrum sativum* L.) is an annual herbaceous seed spice crop grown extensively through out India. Due to its wide adoptability it could be cultivated under a wide range of environmental conditions. Further, it is a crop of significant nutritional as well as medicinal value. It has got acclimatized to accumulated considerable diversity and variation in vegetative, reproductive characters over the years. The average yield of coriander in India due to non availability of region specific genotypes apart from utilization of suitable genotypes, optimum sowing season, nutritional requirement. Very limited scientific information is available on germplasm evaluation of coriander for higher yield under transitional Zone of Karnataka, though farmers are using their own genotypes for cultivation. There is great potential for commercial production of coriander under transitional zone. However, there is no systematic study on the performance of different genotypes. Considering the importance of the crop, there is a prime need to evaluate Coriander genotypes to find out the extent of variability and suitable variety for transitional region. Therefore the present investigation was planned at Horticulture Research Station, Devihosur (Haveri) which comes under Transitional Zone of Karnataka.

Material and Methods
In the present investigation the field experiment was laid out at Horticulture Research Station, Devihosur, Haveri District, Karnataka, in Randomized Complete Block Design (RCBD) for 61 Genotypes in 2 replications. The experimental materials were collected from Horticulture Research Station Devihosur, Haveri District. viz DCC-1 (Devihosuru Coriander Collections)

to DCC-61 including DWR-1 and Ajjampura and which were subjected for evaluation by following the recommended package of practices of UHS, Bagalkot. Observation on various growth an herbage yield related parameters viz Plant height (cm), Number of primary branches, Number of secondary branches, Number of leaves,Fresh weight of the plant (g) Dry weight of the plant (g), Herbage yield (g), Days to 50% flowering, Number of umbels per plant, Number of umbellets per umbel, Number of seeds per umbellet, 1000 seed weight (g), Seed yield per plant (g), Days to maturity, Harvest index (%). were recorded and subjected for analysis as per the Fishers method of ANOVA for drawing the conclusion.

Results and Discussion

The results of the analysis of variance for different quantitative characters of 61 genotypes of coriander are presented in Table 2. The result indicated that there is highly significant (P= 0.01) difference among genotypes for twenty eight characters of growth and yield parameters. This indicated the presence of high degree of variation within the genotypes. Similar were reported by Sharma and Sharma (1989) [14], Sridhar *et al.* (1990 b) [15], Ali *et al.* (1993) [2], Bhandari and Gupta (1993) [4], Beement mengesha and Getine alemaus (2010) [3] in coriander. The magnitude of variance, as such does not reveal the relative amount of variability as ascertained through co-efficient of variation. PCV was higher than GCV for all the characters studied. The characters like plant height at 45 and 60 DAS, number of primary branches at 60 DAS, number of secondary branches at 30 DAS, number of secondary branches at harvest, number of leaves 30, 60 DAS and at harvest, fresh weight of the plant at 30 DAS, fresh weight of the plant at harvest, dry weight of the plant 30, 60 DAS and at harvest, herbage yield, number of umbels per plant at 60 DAS and at harvest, number of umbellets per umbel at harvest, number of seeds per umbellet at 60 DAS and at harvest, thousand seed weight, seed yield per plant, seed yield hectare, crop duration and harvest index showed very narrow differences between phenotypic and genotypic co-efficient of variation indicating less influence of environment in the expression of these characters (refer tables). Thus, selection for these characters would be more effective. The other characters *viz.*, number of primary branches at 30 DAS and at harvest, fresh weight of the plant at 30 DAS, days to fifty per cent flowering and number of umbels per plant at 60 DAS, showed moderate differences between GCV and PCV indicating more sensitive of these characters to environmental factors and thus, response of the selection would be poor. These results are confirmed by the reports of Beement mengesha and Getine alemaus (2010) [3], Kole (2004) [10], Krishnamoorthy and Madalageri (2002) [11] in coriander, fenugreek and ajowan.

High values of PCV was recorded for number of primary branches at harvest, number of leaves at 30 DAS, fresh weight of the plant at 45 DAS, dry weight of the plant at harvest, number of seeds per umbellet at 60 and at harvest and seed yield per plant which indicate that maximum amount of variability is present in genotypes for these characters. These results are in conformity with the results of Singh *et al.* (2005) [16] in coriander. High value of GCV was observed for fresh weight of the plant at 45 DAS, dry weight of the plant at 60 DAS and at harvest, number of seeds per umbellet at 60 DAS and also at harvest, seed yield per plant due to genetic make up of the genotype, indicating that selection of yield attributing character would be more effective. Similar results were obtained by Rajput and Dhirendrasingh (2003) [13] and Abhay *et al.* (2011) [1] in coriander and fenugreek. High PCV with equal GCV estimates were recorded for plant height at 30, 60 DAS, fresh weight of the plant at 30 DAS, dry weight of the plant at 60 DAS, number of seeds per umbellet at 60 DAS and at harvest, thousand seed weight, seed yield per plant, seed yield per hectare indicates maximum variability existing in the genotypes for these characters and offers good scope for improvement by simple selection through these characters. Similar findings were obtained by Rajput and Dhirendrasingh (2003) [13], Patel *et al.* (2008) [12], in coriander and ajowan.

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. Heritability value indicates the heritable properties of variation. Burton and Devane (1953) [5] had suggested that genotypic co-efficient of variation together with heritability estimates would give the best picture of the amount of progress to be expected by selection. In the present study heritability ranged from 10.60 (plant height at 30 DAS) to 99.15 (plant height at 45 DAS). High heritability was noticed for plant height at 45, 60 DAS, number of primary branches at 45 and 60 DAS, number of secondary branches at 45 and 60 DAS, number of leaves 30, 60 DAS and at harvest, fresh weight of the plant at 45 DAS and at harvest, dry weight of the plant at harvest, number of umbellets per umbel at harvest, number of seeds per umbellet at 60 DAS and at harvest, thousand seed weight, seed yield per plant and seed yield per hectare. Similarly, high heritability estimates were also reported by Dhirendra singh *et al.* (2006) [6], Rajput and Dhirendrasingh (2003) [13], indicating that these characters are less influenced by environmental factors and are under the control of additive gene effect for improvement for such character would be rewarding. High genetic advance was observed for number of umbels per plant at 60 DAS and character was controlled by additive gene action; selection for this character will improve the yield. These results are in conformity with the findings of Dhirendra singh *et al.* (2006) [6] in coriander. Low genetic advance was observed for number of primary branches 30 DAS and at harvest, number of secondary branches 30, dry weight of the plant 45 and 60 DAS, number of umbellets per umbel at harvest and crop duration indicating that these characters are governed by non additive gene action and selection for these characters is not useful. Similar, results are reported by Fikreselassie *et al.* (2012b) [7] in fenugreek.

High genetic advance as per cent of mean was observed for number of secondary branches at 30 DAS, number of leaves at 30 DAS, fresh weight of the plant 45 DAS, dry weight of the plant at 45 and 60 DAS and at harvest, herbage yield and number of umbellets per umbel at harvest, number of seeds per umbellet at 60 DAS and at harvest, seed yield per plant and per hectare, indicates that these characters were governed by additive genes and selection will be rewarding for improvement of such traits. Similar results are also reported by Beement mengesh and Getine alemaus (2010) [3], Dhirendra singh *et al.* (2006) [6] in coriander. Moderate genetic advance as per cent of mean was observed for number of primary branches at 30 DAS and number of secondary branches at 30 DAS which indicates that the characters are governed by non additive genes may be useful for heterosis breeding. The heritability has been estimated only in the broad sense and it includes all additive, dominant and epistatic gene effects. However, the heritability in broad sense is an indicator of the possible limit of heritability. Heritability

estimates along with genetic gain (genetic advance as per cent of mean) is more useful than heritability alone in predicting the resultant effect for selecting the best individuals (Johnson *et al.*, 1955) [8]. Genetic advance is the measure of improvement that can be achieved by practicing selection in a population. High heritability with low genetic advance indicates the importance of non-additive gene action, while high heritability with high genetic advance indicates the additive gene effects.

In the present study, high genetic advance over per cent of mean coupled with high heritability was observed in characters for number of secondary branches at 30 and 45 DAS, number of leaves at 30 DAS, fresh weight of the plant at 45 DAS, dry weight of the plant at at harvest, number of umbellets per umbel at 60 and harvest, number of seeds per umbellet at 60 DAS and at harvest, seed yield per plant and seed yield per hectare. Thus, these characters were under additive gene effect and could be improved by simple selection procedure. Crop duration showed high heritability coupled with low genetic advance over mean which indicate the presence of certain degree of non additive gene effect. The high heritability is being exhibited due to favourable influence of environment rather than genotype and selection for such trait may not be rewarding. The findings are in accordance with results reported by Singh *et al.* (2008) [17], Rajput and Dhirendrasingh (2003) [13], Kailashchandra *et al.* (2000) [9] Beement mengesh and Getine alemaus (2010) [3] in coriander and fenugreek.

Table 1: ANOVA for morphometric traits and yield attributes in coriander genotypes

S. No.	Source of variance	Replication	Treatment	Error
1	Plant height (30 DAS)	0.26	0.11NS	0.21
2	Plant height (45 DAS)	0.60	0.27**	0.23
3	Plant height (60 DAS)	0.21	0.85**	0.23
4	Number of primary branches (30 DAS)	0.23	0.20NS	0.27
5	Number of primary branches (45 DAS)	0.72	0.15**	0.20
6	Number of primary branches (60 DAS)	0.51	0.31**	0.25
7	Number of secondary branches (30 DAS)	0.16	0.30NS	0.33
8	Number of secondary branches (45 DAS)	0.19	0.92**	0.20
9	Number of secondary branches (60 DAS)	0.20	0.22**	0.55
10	Number of leaves (30 DAS)	0.62	0.16**	0.59
11	Number of leaves (45 DAS)	0.10	0.25**	0.91
12	Number of leaves (60 DAS)	0.53	0.36**	0.14
13	Fresh weight of the plant (45 DAS)	0.14	0.10**	0.49
14	Fresh weight of the plant (60 DAS)	0.17	0.10**	0.57
15	Fresh weight of the plant (at harvest)	0.40	0.70**	0.26
16	Dry weight of the plant (45 DAS)	0.49	0.28**	0.23
17	Dry weight of the plant (60 DAS)	0.20	0.34**	0.28
18	Dry weight of the plant (at harvest)	0.61	0.56**	0.25
19	Herbage yield	0.23	0.12**	0.81
20	Days to 50% flowering	0.51	0.81**	0.35
21	Number of umbels per plant (60 DAS)	0.13	0.98**	0.56
22	Number of umbels per plant (at harvest)	0.63	0.60**	0.12
23	Number of umbellets per umbel (60 DAS)	0.29	0.13**	0.14
24	Number of umbellets per umbel(at harvest)	0.14	0.97**	0.45
25	Number of seeds per umbellet (60 DAS)	0.47	0.15**	0.26
26	Number of seeds per umbellet (at harvest)	0.59	0.49**	0.37
27	1000 seed weight	0.22	0.62**	0.64
28	Seed yield per plant	0.11	0.31**	0.10
29	Seed yield per ha	0.11	0.42**	0.22
30	Days to maturity	0.85	0.22**	0.97
31	Harvest index	0.76	0.20**	0.87

*-Significant at 5% level, **- Significant at 1% level
NS=Non significant, DAS =Days after sowing

Table 2: Estimates of mean, range, co-efficient of variability, heritability and genetic advance for growth parameters in coriander

Sl. No.	Characters	Mean	Range	Variance			Co-efficient of variability		h^2	GA	GAM
				PV	GV	EV	PCV	GCV			
1	Plant height (30 DAS)	13.18	11.08-15.74	2.20	0.009	2.19	10.60	0.70	10.60	0.01	0.09
2	Plant height (45 DAS)	35.06	28.22-46.18	27.38	27.14	0.24	14.92	14.86	99.15	10.68	30.48
3	Plant height (60 DAS)	53.21	36.52-63.61	78.22	75.84	2.38	16.62	16.37	96.97	17.66	33.20
4	Number of primary branches (30 DAS)	5.90	5.10-6.60	0.34	0.063	0.27	9.86	4.26	18.69	0.22	3.79
5	Number of primary branches (45 DAS)	7.44	5.80-9.90	1.65	1.45	0.20	17.25	16.15	87.65	2.31	31.15
6	Number of primary branches (60 DAS)	8.64	6.70-13.60	3.27	3.01	0.26	20.93	20.09	92.06	3.42	39.70
7	Number of secondary branches (30 DAS)	3.61	2.90-4.70	0.48	0.14	0.34	19.09	10.44	29.87	0.42	11.74
8	Number of secondary branches (45 DAS)	4.79	3.60-7.10	1.03	0.82	0.21	21.19	18.94	79.88	1.67	34.88
9	Number of secondary branches (60 DAS)	8.81	5.30-21.20	22.29	21.74	0.55	53.58	52.92	97.53	9.48	107.66
10	Number of leaves (30 DAS)	20.00	15.90-31.90	17.16	16.56	0.60	20.71	20.35	96.54	8.23	41.19
11	Number of leaves (45 DAS)	25.77	19.90-38.70	26.46	25.54	0.92	19.96	19.61	96.53	10.22	39.69
12	Number of leaves (60 DAS)	29.40	22-42.60	36.95	35.51	1.44	20.67	20.27	96.12	12.03	40.94
13	Fresh weight of the plant (45 DAS)	10.44	6.58-16.56	12.97	8.01	4.96	34.47	27.11	61.83	4.58	43.91

14	Fresh weight of the plant (60 DAS)	12.04	8.14-18.26	13.45	7.71	5.74	30.45	23.07	57.36	4.33	35.99
15	Fresh weight of the plant (at harvest)	7.32	4.54-13.21	8.39	5.76	2.63	39.59	32.82	68.69	4.09	56.03
16	Dry weight of the plant (45 DAS)	1.97	1.38-2.94	0.40	0.16	0.24	32.27	20.81	41.71	0.54	27.69
17	Dry weight of the plant (60 DAS)	2.73	1.71-3.96	0.49	0.20	0.29	25.65	16.76	42.67	0.61	22.55
18	Dry weight of the plant (at harvest)	6.93	3.20-12.55	6.93	4.41	2.52	41.20	32.88	63.68	3.45	54.05

Table 3: Estimates of mean, range, co-efficient of variability, heritability and genetic advance for yield parameters in coriander

S. No.	Characters	Mean	Range	Variance			Co-efficient of variability		h^2	GA	GAM
				PV	GV	EV	PCV	GCV			
1	Herbage yield	10.86	6.61-16.56	14.49	8.05	6.44	35.04	26.13	55.60	4.35	40.13
2	Days to 50% flowering	45.09	42.50-50	8.34	7.98	0.36	6.40	6.27	95.72	5.69	12.62
3	Number of umbels per plant (60 DAS)	25.86	15-42.20	101.19	95.49	5.70	38.90	37.79	94.37	19.55	75.63
4	Number of umbels per plant (at harvest)	22.47	12.90-34.40	66.66	53.93	12.73	36.34	32.69	80.90	13.60	60.56
5	Number of umbellets per umbel (60 DAS)	6.68	4.80-8.50	1.38	1.23	0.15	17.60	16.62	89.17	2.15	32.33
6	Number of umbellets per umbel(at harvest)	6.72	5.40-8.90	1.20	0.75	0.45	16.28	12.85	62.29	1.40	20.89
7	Number of seeds per umbellet (60 DAS)	9.15	5.30-21.50	16.35	13.68	2.67	44.16	40.41	83.70	6.97	76.15
8	Number of seeds per umbellet (at harvest)	20.03	12.30-37	51.86	48.06	3.80	35.95	34.61	92.68	13.75	68.64
9	1000 seed weight	13.04	9.20-17.08	6.61	5.96	0.65	19.71	18.73	90.27	4.77	36.66
10	Seed yield per plant	3.54	1.76-7.19	2.27	1.78	0.49	42.51	37.75	78.85	2.44	69.06
11	Seed yield per ha	11.90	5.87-23.97	25.72	20.57	5.15	42.62	38.12	79.98	8.35	70.23
12	Days to maturity	89.29	86.50-94.50	3.64	2.60	1.04	2.13	1.81	71.50	2.81	3.14
13	Harvest index	49.18	39.37-65.90	53.38	31.00	22.38	14.85	11.32	58.07	8.74	17.77

GV- Genotypic variance
PV- Phenotypic variance, h^2- Broad sense heritability
EV- Environmental variance, GA- Genetic advance
GCV- Genotypic co-efficient of variation, GAM- Genetic advance as per cent of mean
PCV- Phenotypic co-efficient of variation, DAS- Days after sowing

Summary
The analysis of variance revealed highly significant difference among genotypes for twenty eight characters. The phenotypic coefficient of variation was more than genotypic coefficient of variation for all the characters studied. High heritability coupled with high genetic advance as per cent of mean was observed for characters like plant height, number of primary branches, number of secondary branches, number of leaves, fresh weight of the plant, dry weight of the plant at harvest, number of umbels per plant, number of umbellets per umbel, thousand seed weight, number of seeds per umbellet, seed yield per plant. The present investigation also identified DCC 28, DCC 38, DCC 42, DCC 47, DCC 57 and DCC 5 as a promising genotypes for both herbage and seed yield under transitional zone of Karnataka.

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