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Genetic Variability, Heritability and Genetic Advance Studies in Coriander (*Coriandrum sativum* L.)

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ABSTRACT

The genetic improvement of coriander depends mainly on the substantial magnitude of variability in the genotypes. The study was under taken on sixteen coriander varieties using Randomized Complete Block Design with three replications. The varieties of coriander exhibited significant differences for all the characters studied, except for the number of seeds per umbellet. High genotypic and phenotypic coefficient of variation was observed for characters like seed yield per plant, seed yield per hectare, test weight, harvest index, plant spread and dry weight of plant. High heritability coupled with high genetic advance as per cent mean was observed for plant spread, fresh and dry weight of plant, number of umbellets per umbel, seed yield per plant and seed yield per hectare, which might be assigned to additive gene effect governing their inheritance for these traits. Therefore, greater emphasis should be given on these characters while selecting for higher yield and related traits.

Key words: *Coriandrum sativum, Genetic variability, Heritability, Genetic advance, Harvest index*

INTRODUCTION

Coriander commonly known as “Dhania” (*Coriandrum sativum* L.) is an annual herb, belongs to family Apiaceae and possess 2n=22 chromosomes with cross-pollination as mode of reproduction. Leaves are alternate, compound and petiolate with a pair of stipules. Inflorescence is a compound umbel. Corolla is comprised of five petals. Fruit is a schizocarp, globular or round and white to light brown in colour[4,9]. Coriander is also known as the Chinese parsley, Cilantro, Dizzy corn and Japanese parsley, growing to 60 - 80 cm tall, with tiny flowers in the umbel, which are protandrous in nature. It is also noticed that about 50 per cent self-incompatibility exists and thus, cross pollination by insects is the rule.

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Hybridization by artificial crossing is rather laborious due to small size of flower buds and mechanical selfing or bagging of the buds, which invariably results in flower shedding[8]. Hence, systematic germplasm collection and selection of promising types from the gene pool is the most useful method of crop improvement in coriander. Western Europe and Asia are considered to be center of origin of this crop[7]. In India, coriander is mainly cultivated in Rajasthan and Gujarath with a sizeable acreage in Madhya Pradesh, Haryana, Punjab, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Bihar and to a limited extent in Karnataka. Presently it occupies an area of 4.47 lakh hectares with the production of 482 lakh tonnes with a productivity of 0.7 tonnes per hectare[1]. To make this crop more productive and resistant to diseases and insect-pest, breeders have to launch an intensive breeding programme for releasing array of variability. Development of high yielding cultivars requires knowledge of the existing genetic variation and also the extent of association among yield contributing characters.

The observed variability is a combined estimate of genetic and environmental causes of which only the genetic variability is heritable. However, the estimate of heritability alone does not provide an idea of the expected gain in the next generation but it has to be considered in conjunction with genetic advance. Keeping this in view, the present investigation was made to explore the genetic variability, by determining the magnitude of genetic coefficient of variation, heritability estimates and expected genetic advance of different biometric traits effects in sixteen coriander varieties.

MATERIAL AND METHODS

The experimental material comprised of sixteen coriander varieties (RCr-684, RCr-728, RCr-446, RCr-20, RCr-436, RCr-41, RCr-480, RCr-475, RCr-435, ACr-1, GCo-1, GCo-2, CO-1, CO-2, CO-3, CO(CR)-4) and were sown during *rabi* season of 2016-2017 under Randomized Complete Block Design with three replications at Dept. of PSMA, College of Horticulture, UHS Campus, GKVK, Bengaluru, located at an altitude of 930 m above MSL at $12^{o}58^{1}$ North Latitude and $77^{o}35^{1}$ East Longitude lying in the Eastern Dry Zone (zone-5) of Karnataka. Sowing was done on November, 6^{th} 2016 at a spacing of 30 X 10 cm (shallow depth of 1-1.5cm) and seeds germinated in 10 days. The recommended dose of manures and fertilizers (20 t FYM and 60:40:20 kg NPK/ha) were applied at the time of field preparation. All the agronomic package of practices was adopted to grow a healthy crop.

In each replication and in each treatment five plants were randomly selected and tagged for observation. Periodically, observations recorded on plant height (cm), plant spread (cm^2), days to first flowering, days to 50% flowering, number of primary branches, number of secondary branches, number of umbels per plant, number of umbellets per umbel, numbe of seeds per umbellet, fresh and dry weight of plant (g), test weight (g), harvest index (%), days to seed maturity, seed yield per plant (g) and seed yield per hectare (q). Data was analyzed for different parameters by method suggested by Panse and Sukathme[15]. The phenotypic and genotypic co-efficient of variability was calculated as per the formula suggested by Burton[3], Falconer[6] for heritability in broad sense and Johnson *et al.*[10] for genetic advance.

RESULTS AND DISCUSSION

Analysis of variance revealed significant differences among the varieties for all the characters studied except for number of seeds per umbellet indicating presence of significant variability in the materials (Table 1). The range of variance was high for plant spread (729.20 to 1470.40) followed by days to seed maturity (90.50 to 111.00) and plant height (70.50 to 99.45). In general the phenotypic coefficient of variance was higher than the genotypic coefficient of variance for all the traits indicating considerable influence of environmental on their expression. (Table 2).

The phenotypic coefficient of variance varied from 6.93 (days to seed maturity) to 30.41 (seed yield per plant) similar result have been reported by Mandal and Hazara[11]. The PCV expressed in terms of percentage were comparatively high for seed yield per plant, test weight, harvest index, dry weight of plant and number of umbels per plant. As the estimates of phenotypic variability cannot differentiate between the effect of genetic and environmental effect, so the study on genetic variability is in partitioning out the real genetical difference. Higher the GCV, more the chance of improvement in that characters. In the present investigation, GCV were comparatively high for seed yield per plant, dry weight of plant, plant spread, test weight and harvest index (Table 2). Similar results were obtained by Megeji and Korla[13], Sarada and Giridhar[16] and Meena *et al*.[14] in coriander. The GCV is less than the corresponding PCV, indicating the role of environment in the expressive of the traits under observation. The difference between GCV and PCV were more in case of number of primary branches, number of umbels per plant, and number of seeds per umbellet. The large difference between GCV and PCV indicated that environment effect to a large extent influenced the traits. The characters having high GCV possessed better potential for further gain and improvement.

Heritability estimates were high for seed yield per plant, seed yield per hectare, plant spread, plant height, fresh and dry weight of plant and number of umbellets per umbel (Table 2). Similar findings were also reported by Bhavani Shanker and Abdul Khader[2], Megeji and Korla[13], Dhirendra Singh *et al*.[5] and Sravanthi *et al.*[17] in coriander. High heritability does not mean a high genetic advance for a particular quantitative character. Johnson *et al*.[10] reported that, heritability estimated along with genetic advance would be more rewarding than heritability alone in predicting the consequential effect of selection to choose the best individual as it suggest the presence of additive gene effects. High heritability coupled with high genetic advance as per cent mean were noticed for plant spread, fresh and dry weight of plant, number of umbellets per umbel, seed yield per plant and seed yield per hectare, which might be assigned to additive gene effect governing their inheritance and these traits are more reliable for direct selection (Table 2). Similar findings have been reported by Meena *et al.*[12]. Therefore, improvement in these traits would be more effectively done through selection in the present materials.

Table 1: Analysis of Variance for sixteen characters in coriander varieties

Source of variation	Degrees of freedom	Mean sum of squares															
		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16
Treatments	15	154.16**	99636.17**	5.86*	12.31*	15.13**	4.85**	15.73*	29.30*	54.87*	2.72**	0.80	71.97*	17.19*	306.97*	4.65**	12.00**
Replication	2	2366.72	27144.50	1.09	0.18	13.12	0.48	6.13	8.00	2.88	1.94	0.00	28.13	0.81	2183.45	0.84	16.52
Error	30	19.60	6434.76	2.06	4.51	2.05	0.49	5.39	9.33	17.64	0.61	0.41	25.86	5.46	90.28	0.20	2.14
CV (%)	-	5.21	8.30	16.37	13.56	10.65	11.17	5.49	6.19	17.98	13.74	12.04	5.04	20.42	19.27	8.77	13.75

*Significant at 5 per cent probability level and ** Significant at 1 per cent probability level

X1: Plant height at harvest (cm)
X2: Plant spread (cm^2)
X3: Number of primary branches per plant
X4: Number of secondary branches per plant
X5: Fresh weight of plant (g)
X6: Dry weight of plant (g)
X7: Days to first flowering
X8: Days to fifty per cent flowering
X9: Number of umbels per plant
X10: Number of umbellets per umbel
X11: Number of seeds per umbellet
X12: Days to seed maturity
X13: Test weight (g)
X14: Harvest index (%)
X15: Seed yield per plant (g)
X16: Seed yield per ha (q)

Table 2: Estimates of variability and genetic parameters for growth and yield traits in coriander varieties

Sl. No	Character	Range		Mean	Co-efficient of variability (%)		Heritability (%)	GA	GA as per cent mean
		Minimum	Maximum		Phenotypic	Genotypic			
1	Plant height (cm)	70.50	99.45	84.94	10.97	9.66	77.44	14.87	17.50
2	Plant spread (cm^2)	729.20	1470.40	966.07	23.84	22.35	87.87	416.85	43.15
3	Days to first flowering	38.50	47.50	42.31	7.68	5.37	48.93	3.28	7.74
4	Days to 50 per cent flowering	44.50	58.00	49.38	8.90	6.40	51.68	4.68	9.48
5	Number of primary branches	7.10	13.65	8.76	22.71	15.75	48.07	1.97	22.49
6	Number of secondary branches	10.30	21.15	15.66	18.52	12.60	46.33	2.77	17.67
7	Number of umbels per plant	15.35	31.70	23.36	25.78	18.47	51.35	6.37	27.27
8	Number of umbellets per umbel	4.49	8.25	5.67	22.75	18.13	63.51	1.69	29.76
9	Number of seeds per umbellet	4.74	7.35	5.30	14.66	8.37	32.58	0.52	9.84
10	Days to seed maturity	90.50	111.00	100.88	6.93	4.76	47.13	6.79	6.73
11	Fresh weight of plant (g)	9.02	17.65	13.44	21.80	19.02	76.12	4.60	34.18
12	Dry weight of plant (g)	3.21	9.64	6.28	26.02	23.50	81.57	2.75	43.72
13	Seed yield per plant (g)	3.01	7.36	5.12	30.41	29.11	91.67	2.94	57.42
14	Seed yield per hectare (q)	7.28	14.35	10.64	24.98	20.86	69.69	3.82	35.87
15	Test weight (g)	9.20	19.50	11.41	29.41	21.17	51.79	3.59	31.38
16	Harvest index (%)	29.55	71.38	49.30	28.59	21.11	54.55	15.84	32.12

GA: Genetic advance

Fig. 1: Genotypic variation for plant height and flowering

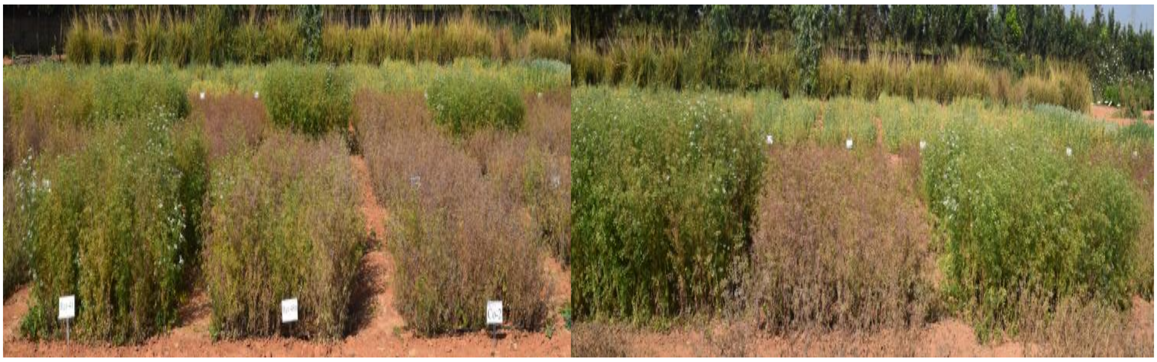

Fig. 2: Genotypic variation for days to maturity

CONCLUSION

Depending upon the variability, heritability and genetic advance estimates, it could be predicted that improvement by direct selection was possible in coriander for traits like seed yield per plant, seed yield per hectare, number of umbellets per umbel, plant spread, plant height, fresh and dry weight of plant. Therefore, these characters should be considered while making selection for yield improvement in coriander.

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