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Studies on genetic variability in coriander (*Coriandrum sativum* L.)

Ravi Kumar Yadav, Dr. DP Mishra and Dr. GC Yadav

Abstract
The present investigation entitled was executed at Main Experiment Station Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) during *Rabi* 2019-20 to estimate the genetic variability among the genotypes of coriander. Experimental material for the study consisted of 72 genotypes including two checks (Hisar Anand and N.D. Cor. 2). The experiment was conducted in Augmented Design in 7 blocks (10 genotypes + 2 checks in each block). Observations were recorded on 11 quantitative traits *viz*. plant height, number of branches per plant, number of nodes per plant, days to 50% flowering, umbel diameter (cm), number of umbels per plant, number of umbellets per umbel, number of fruits per umbel, number of fruits per umbellate, 1000 seed weight (g) and seed yield per plant (g). The variation due to the blocks were highly significant for all the characters except fruits per umbel was significant and variation due to checks were highly significant for all the characters except non-significant for fruits per umbel. Based on mean performance of seed yield and yield components, the genotypes NDCor-91 followed by NDCor-81, NDCor-72, NDCor-52 and NDCor-105 were identified as most promising genotypes for yield and major component traits. High magnitudes of variability were observed for umbels per plant. High heritability (broad sense) along with high genetic advance in per cent of mean were estimated for plant height (cm), Number of nodes per plant, yield per plant (g), test weight (g), umbel diameter (cm), umbellets per umbel, fruits per umbellate, branches per plant, umbels per plant, and fruits per umbel.

Keywords: Studies, genetic, variability, coriander, *Coriandrum sativum* L.

Introduction
Coriander is also known as Chinese parsley, cilantro, dizzy corn, and Japanese parsley. India is also known as "Land of spices". Coriander is indispensable spices in the kitchen. It is among the first spices used as mankind, have been known as early as 5000 BC. Moreover, reference is also available with regard to Indian spices and their uses in Vedas (6000 B.C.) by Manu (4000 B.C.). India is biggest producer, consumer and exporter of coriander in the whole world. According to bureau of Indian standards, 63 kinds of spices are grown in the country. Mainly, 52 spices are grown in India according to spices of board, Calicut, Kerala. Coriander is the one of the most important seed spices crop grown throughout the world. Coriander is botanically known *Coriandrum sativum* L., 2n=2x=22, which belong the family Apiaceae. It is annual, herbaceous plant which originated from the Mediterranean and Middle Eastern regions. It is mainly cultivated for its fruits as well as for the tender green leaves throughout the year. Coriander is now commercially grown in India, Morocco, U.S.S.R., Hungry, Poland, Rumania, Czechoslovakia, Guatemala, Mexico and the USA. In India, it is grown in Rajasthan, Madhya Pradesh, Gujarat, Assam, Andhra Pradesh, Orissa and Uttar Pradesh etc.
Genetic variability forms the basis for crop improvement. The success of any breeding programme depends upon the nature and the magnitude of variability available in the breeding materials. Selection and hybridization approaches are easily followed in bringing about the quantitative improvement. Hance, it is essential to assess the nature and magnitude of variability, heritability and genetic advance for various characters in respect of germplasms available for maximizing the correlated response to selection. Besides, knowledge of inter character association, direct and indirect effects on seed yield is also essential.

Materials and Methods
The present research work entitled was carried out during winter season 2019-20, at the Main Experiment Station, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology (Narendra Nagar), Kumarganj, Ayodhya (U.P.).

Experimental material for the study consisted of 72 genotypes including two checks (Hisar Anand and N.D. Cor. 2) selected on the basis of genetic variability from the germplasm stock maintained in the Department of Vegetable Science, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) India. The experiment was conducted in Augmented Design in 7 blocks (10 genotypes + 2 checks in each block. Observations were recorded on 11 quantitative traits *viz*. plant height, number of branches per plant, number of nodes per plant, days to 50% flowering, umbel diameter (cm), number of umbels per plant, number of umbellets per umbel, number of fruits per umbel, number of fruits per umbellate, 1000 seed weight (g) and seed yield per plant (g). The analysis of variance was carried out as per Panse and Sukhatme (1967), GCV and PCV as per method suggested by Burton and De Vane (1953) [1], heritability in broad sense Hanson *et al.* (1956) [2] and genetic advance Johnson *et al.* (1955) [3].

Result and Discussions

The result of analysis of variance for Augmented Design was carried out for 11 characters and the results obtained are presented in table 1.

The variation due to the blocks were highly significant for all the characters except fruits per umbel was significant and variation due to checks were highly significant for all the characters except non-significant for fruits per umbel.

Plant height (cm) is varied from 84.50 (NDCor-54) to 150.00 (NDCor-83) with general mean of 129.82. Top five genotypes NDCor-83, NDCor-05, NDCor-41, NDC or-42 and NDC or-113 were found significantly superior than best check Hisar Anand (140.75) for this trait.

Branches per plant varied from 3.00 (NDCor-121) to 11.33 (NDCor-51) with general mean of 9.76. Top five genotypes NDCor-51, NDCor-83, NDCor-53, NDCor-52 and NDCor-45 were found significantly superior than best check Hisar Anand (5.58) for the Branches per plant.

Nodes per plant 5.5 (NDCor-112) to 14.25 (NDCor-51) with general mean of 7.14. Top five genotypes NDCor-51, NDCor-83, NDCor-81, NDCor-45 and NDCor-84 were found significantly superior than best check Hisar Anand (12.15) for Fruiting nodes. Days to 50% flowering ranged from 85.77 (NDCor-80) to 95.43 days (NDCor-1) with general mean of 90.69 days. Top five genotypes NDCor-84, NDCor-12, NDCor-105, NDCor-134 and NDCor-82 were found significantly superior than best check Hisar Anand (90.75) for this trait. Umbel diameter (cm) ranged from 4.03 (NDCor-12) to 7.61 (NDCor-15) with general mean of 6.11. Top five genotypes NDCor-15, NDCor-33, NDCor-134, NDCor-135 and NDCor-11 were found significantly superior than best check Hissar.

Table 1: Analysis of variance (Augmented design) for eleven characters in coriander germplasm.

Characters	Sources of variation		
	Blocks	Checks	Error
	6 (d. f)	1 (d. f)	6
Days to 50% flowering	8.4645 ***	0.875***	0.00008
Plant height (cm)	88.54467***	6.20417***	-0.0072
Branches per plant	15.974***	0.983***	-0.00
Nodes per plant	7.0819***	0.0087***	0.00004
Umbel diameter (cm)	0.1649***	0.0349***	0
Umbels per plant	143.243***	5.373***	0.00139
Fruits per umbel	54.328*	43.0156	8.0102
Umbellets per umbel	0.657***	0.0057***	0.00001
Fruits per umbellate	1.006***	0.946***	-0.000
1000 seed weight (g)	2.1282***	0.745***	0.0000
Seed yield per plant (g)	3.627***	0.2015***	0.00001

(*) Significant at 5% probability level, (**) Significant at 1% probability level

Table 2: Adjusted means of genotypes and mean checks, range and least significant differences for 11 characters in Coriander.

S. No.	Characters Genotype	Days to 50% flowering	Plant height (cm)	Branches/ plant	Nodes/ plant	Umbel diameter (cm)	Umbels/ plant	Fruits/ umbel	Umbellets/ umbel	Fruits/ umbellate	1000 seed weight (g)	Seed yield/ plant (g)
1	NDCor-1	85.77	121.66	7.33	8.33	4.64	20.75	32.5	7	6.5	9.71	8.23
2	NDCor-3	90.77	116.66	7.33	9	5.37	14.25	29	5.25	5.5	7.95	7.37
3	NDCor-4	92.77	142	8.66	13.66	4.82	26.75	34.5	7.25	6.75	12.79	11.71
4	NDCor-5	90.77	145.33	9	10	5.72	58.75	26.5	5	5.25	8.01	6.93
5	NDCor-11	92.77	115	7.66	12.5	7.5	58.25	51.25	5.25	6.5	8.73	7.23
6	NDCor-12	94.77	108.33	7.33	9	4.03	24.5	30.75	4.25	7.25	7.57	6.89
7	NDCor-13	92.77	126.66	5.33	9.66	5.73	20.25	25.75	4.5	5.75	7.71	7.63
8	NDCor-14	85.77	143.33	6	8.66	7.27	22.75	51.95	5.5	7.25	8.95	8.21
9	NDCor-15	88.77	123.75	6.33	9.66	7.61	19	52.25	5.25	6.5	12.09	10.11
10	NDCor-21	88.77	133.35	8.66	13.66	5.59	30.25	27.75	5.25	5.25	10.09	9.27
11	NDCor-22	85.77	133.33	8.66	9.33	6.59	30	28.25	5.25	5.25	10.67	9.81
12	NDCor-23	89.77	120	8.66	13.95	5.74	18	36.5	5.75	7	11.41	8.31
13	NDCor-24	89.77	131.66	7.66	13.95	5.96	22.25	33	8.25	5.25	8.71	8.11
14	NDCor-25	89.77	140	7.66	14	6.47	20	40.75	5	6.5	7.95	7.51
15	NDCor-31	88.77	143.95	7.5	10	5.47	16.75	35	7.25	7	9.35	8.43
16	NDCor-32	89.77	144.5	7.75	7.25	5.16	16	25	5	5	10.34	9.94
17	NDCor-33	90.77	124.5	7	8.25	7.56	15.75	52.25	5	5	11.32	10.74
18	NDCor-34	90.77	128.75	7.5	7.75	7.22	15	51.85	7.45	5.75	8.34	6.92
19	NDCor-35	89.77	126.75	6.75	7.5	6.75	16.5	34	4.75	7.25	9.52	8.62
20	NDCor-41	88.77	145.35	7.25	6.75	5.92	26.25	30	5	6	10.34	9.78
21	NDCor-42	85.77	145	7	7.25	6.85	18.75	51.25	5.25	6.5	10.38	9.5
22	NDCor-43	89.77	142	8.66	7.25	6.17	17.5	37	5.5	6.75	11.02	10.08
23	NDCor-44	90.77	128.75	8.66	9.66	6.95	16.75	52.25	7	8.75	8.52	7.84
24	NDCor-45	88.77	142.25	10	14	6.01	19.5	32.5	7	6.5	8.92	8.24
25	NDCor-51	90.77	137	11.33	14.25	5.96	19.25	33.25	5.75	6.25	9.7	8.38
26	NDCor-52	90.43	121.66	10.33	13.66	5.78	19.5	32.75	5.25	5.75	12.46	11.85
27	NDCor-53	90.43	113.33	10.33	11.66	5.73	27.5	33.25	5.25	6.25	11.24	11.01
28	NDCor-54	88.43	84.5	9.66	11.33	6.01	26	35.75	5.25	6.75	9.12	7.55
29	NDCor-55	88.43	115	9.66	9	6.33	27.75	38.25	5.5	7	7.84	6.93
30	NDCor-61	90.43	135	8	9.5	5.93	26.25	28.75	7.25	5.75	12.42	11.31

31	NDCor-62	89.77	100	6.75	7	6.62	15	51	5.5	7	10.34	10.01
32	NDCor-63	88.77	127.5	7.25	9.25	5.45	21.25	53.25	6.25	6.5	13.54	14.49
33	NDCor-64	90.77	128.75	7	8.75	6.33	20	36.75	5.25	7	8.04	7.43
34	NDCor-65	88.77	118.75	8	9.5	6.15	17.75	36.75	5.25	7	8.06	8.33
35	NDCor-71	90.77	143.75	8	13.5	6.02	20.25	35.75	8.95	5	12.02	11.85
36	NDCor-72	92.1	137	7.5	11	5.79	19.4	38	5.75	5	12.02	12.36
37	NDCor-73	94.1	120	7	9.25	5.94	23.75	37.75	6.75	6.5	7.16	7.48
38	NDCor-74	92.1	142.25	6.25	10.5	5.96	15	37.75	7.25	5.5	8.08	8.54
39	NDCor-75	92.1	130	8.5	10.25	6.3	21.5	28.5	5.75	5.75	7.92	8.24
40	NDCor-81	90.1	117.5	7	14	6.2	19	28.75	5.5	5.25	12.86	12.58
41	NDCor-82	94.43	102.5	7.5	8.5	6.02	20.5	35.75	5.5	6.5	8.07	7
42	NDCor-83	88.43	150	10.5	14.25	6	37.5	32.5	8	7.5	9.85	11.86
43	NDCor-84	95.43	136.95	8	13.95	6.14	29.25	37.5	7.25	6.5	9.13	8.14
44	NDCor-85	93.43	143	9	13	6.46	31.25	31.75	5.5	5.75	8.27	7.32
45	NDCor-91	94.43	131.65	8.75	10	6.08	30.75	31.75	5.75	5.5	13.35	12.74
46	NDCor-92	87.43	132.35	5.55	6.75	6.22	18.5	40	6.65	7	6.87	6.45
47	NDCor-93	89.43	142.58	5.75	9.66	6.3	25	44.5	6.25	7	8.09	8.09
48	NDCor-94	91.43	136.25	4.5	7.25	6.26	15.75	45.5	6.25	7.25	9.75	9.61
49	NDCor-95	92.43	134.25	5	6.75	6.22	17.75	29.25	6.25	4.75	7.67	7.41
50	NDCor-101	91.43	120	8.75	10	5.93	18.25	35	5.75	6	6.17	5.85
51	NDCor-102	92.77	133.75	4.25	7	5.64	14.5	40.5	6.5	6.25	9.71	8.23
52	NDCor-103	92.77	132.25	6	7	6.22	21.75	32	6	5.25	8.84	8.5
53	NDCor-104	92.77	132	5.5	13.25	6.37	15.5	31.5	5.5	5.75	7.95	7.37
54	NDCor-105	94.77	120	6	13.25	5.82	13	37.25	5.75	6.5	12.79	11.71
55	NDCor-111	88.77	131.45	4.75	6.5	5.72	24.5	41.75	6.25	6.75	8.01	6.93
56	NDCor-112	88.77	130.25	6	5.5	6.5	20.75	35.75	5.5	6.5	8.73	7.23
57	NDCor-113	90.77	144.35	3.5	5.75	5.03	22	48.75	6.25	7.75	7.57	6.89
58	NDCor-114	90.77	132.66	5.5	12.95	6.73	19.5	34	5.75	5.75	7.71	7.63
59	NDCor-115	90.77	142.95	4.25	6.5	6.27	20.5	51.95	6	6	8.95	8.21
60	NDCor-121	93.43	128.25	3	5.75	6.61	19.5	52.25	6.5	6.25	12.09	10.11
61	NDCor-122	94.43	142.75	6.25	7.25	6.59	20	37.5	7.95	6.25	10.09	9.27
62	NDCor-123	87.43	144.11	5.25	13	6.4	18	31.75	8.25	5.5	10.67	9.81
63	NDCor-124	89.43	135.25	5.75	12.95	5.74	14.5	34.5	8.25	5.75	11.41	8.31
64	NDCor-125	91.43	136.75	7.25	7	5.96	21	27.5	5.5	5	8.71	8.11
65	NDCor-131	92.43	128.25	6	12.95	5.47	12.25	28.75	5.25	5.5	7.95	7.51
66	NDCor-132	90.77	115.75	5	7	5.47	17.75	27.5	4.75	5.75	9.35	8.43
67	NDCor-133	92.77	116.25	4.75	6	5.16	19.25	31	5.25	6	10.34	9.94
68	NDCor-134	94.77	126	4.25	6.5	7.56	19.25	25.5	5.5	4.75	11.32	10.74
69	NDCor-135	92.77	119.25	8.75	7	7.22	12.5	53.55	5	5	8.34	6.92
70	NDCor-136	86.43	120.95	7.85	6.5	5.82	20.75	34.5	4.75	5.75	10.85	6.89
71	Hissar Anand	90.75	140.75	5.58	12.15	6.12	55.18	46.27	6.73	6.46	9.3	8.74
72	NDCor-2	91.25	142.08	6.11	12.2	6.22	56.42	49.78	6.69	6.98	8.84	8.5
	Mean	90.69	129.82	9.76	7.14	6.11	21.64	36.99	5.97	6.16	9.60	8.84
	C. V. %	9.69	13.14	7.11	9.82	6.10	22.59	37.29	5.99	6.17	9.58	8.83
	C.D. (5%)	0.0387	0.3597	0.022	0.026	0.0075	0.1582	11.990	0.0134	0.0190	0.0219	0.0111
	Lowest	85.77	84.50	3.00	5.5	4.03	13.00	25.00	4.50	4.75	6.17	5.85
	Highest	95.43	150.00	11.33	14.25	7.61	58.75	53.55	8.95	8.75	13.54	14.49

Anand (6.12) for this trait. Umbels per plant varied from 12.50 (NDCor-135) to 58.45 (NDCor-05) with general mean of 21.64. Top five genotypes NDCor-11, NDCor-85, NDCor-91, NDCor-21 and NDCor-22 were found significantly superior than best check Hissar Anand (55.18) for this trait. Fruits per umbel varied from 25.00 (NDCor-32) to 53.55 (NDCor-135) with general mean of 36.99. Top five genotypes NDCor-135, NDCor-63, NDCor-33, NDCor-44 and NDCor-121 were found significantly superior than best check Hissar Anand (46.27) for this trait. Umbellets per umbel varied from 4.25 (NDCor-12) to 8.95 (NDCor-71) with general mean of 5.97. Top five genotypes NDCor-123, NDCor-124, NDCor-04, NDCor-122 and NDCor-61 were found significantly superior than best check Hissar Anand (6.73) for this trait.

Fruits per umbellate varied from 4.75 (NDCor-134) to 8.75 (NDCor-44) with general mean of 6.16. Top five genotypes NDCor-12, NDCor-14, NDCor-35, NDCor-94 and NDCor-23 were found significantly superior than best check NDCor-2 (6.46) for this trait. 1000 seed weight (g) ranged from 6.17 (NDCor-101) to 13.54 (NDCor-63) with general mean of 9.60. Top five genotypes NDCor-04, NDCor-81, NDCor-91, NDCor-105 and NDCor-52 were found significantly superior than best check Hissar Anand (9.30) for this trait. Seed yield per plant (g) varied from 5.85 (NDCor-101) to 14.49(NDCor-63) with general mean of 8.84. Top five genotypes NDCor-91, NDCor-81, NDCor-72, NDCor-52 and NDCor-105 were found significantly superior than best check Hissar Anand (8.74) for this trait.

A very wide range of variation in mean performance of genotypes was observed for all the characters under study. The comparison of mean performance of seventy genotypes for eleven traits using least significant differences revealed existence of high level of variability in the germplasm collection. The genotypes showing high mean performance in desirable direction for various characters are listed in table 3, which may be used as donors for improving the characters for which they had high mean performance. The analysis of variance for all the eleven traits showed existence of variability among the seventy germplasm. The phenotypic variability may be due to genetic constitution of the material as well as environment influences. The range, general means, phenotypic coefficient of variation (PVC) and genotypic coefficient of variation (GCV), heritability in broad sense, genetic advance and genetic advance in per cent of mean for different character of coriander (*Coriandrum sativum* L.) germplasm are presented in table 4. The phenotype coefficient of variance was estimated in 72 genotypes for 11 characters.

Table 3: The superior genotypes of coriander for different characters based on mean performance

S. No.	Characters	Genotypes				
		1	2	3	4	5
1.	Days to 50% flowering	NDCor-54	NDCor-12	NDCor-105	NDCor-134	NDCor-82
2	Plant height (cm)	NDCor-83	NDCor-05	NDCor-41	NDCor-42	NDCor-113
3	Branches per plant	NDCor-51	NDCor-83	NDCor-53	NDCor-52	NDCor-45
4	Nodes per plant	NDCor-51	NDCor-83	NDCor-81	NDCor-45	NDCor-84
5	Umbel diameter (cm)	NDCor-15	NDCor-33	NDCor-134	NDCor-135	NDCor-11
6	Umbels per plant	NDCor-11	NDCor-85	NDCor-91	NDCor-21	NDCor-22
7	Fruits per umbel	NDCor-135	NDCor-63	NDCor-33	NDCor-44	NDCor-121
8	Umbellets per umbel	NDCor-123	NDCor-124	NDCor-04	NDCor-122	NDCor-61
9	Fruits per umbellate	NDCor-12	NDCor-14	NDCor-35	NDCor-94	NDCor-23
10	1000 seed weight (g)	NDCor-04	NDCor-81	NDCor-91	NDCor-105	NDCor-52
11	Seed yield per plant (g)	NDCor-91	NDCor-81	NDCor-72	NDCor-52	NDCor-105

Table 4: Estimates of range, general mean, genotypic and phenotypic coefficient of variation, heritability, genetic advance and genetic advance in per cent of mean for 11 characters in coriander.

Parameters Characters	Range		General mean	Genotypic coefficients of variation	Phenotypic coefficients of variation	Heritability (%)	Genetic advance	Genetic advance in percent of mean
	Min.	Max.						
	1	2	3	4	5	6	7	8
Days to 50% flowering	85.77	95.43	90.69	2.46	2.46	75.00	4.59	5.07
Plant height (cm)	84.50	150.00	129.82	9.04	9.04	99.00	24.19	18.63
Branches per plant	3.00	11.33	7.14	23.47	23.47	88.75	3.45	48.35
Nodes per plant	5.55	14.25	9.76	26.87	26.87	98.12	5.40	55.36
Umbel diameter (cm)	4.03	7.61	6.11	10.45	10.45	95.12	1.31	21.53
Umbels per plant	13.00	58.75	21.64	35.23	35.24	95.00	15.70	72.59
Fruits per umbel	25.00	53.55	36.99	19.98	21.39	87.00	14.21	38.43
Umbellets per umbel	4.50	8.95	5.97	16.30	16.30	93.55	2.00	33.58
Fruits per umbellate	4.75	8.75	6.16	12.47	12.47	90.42	1.58	25.67
1000 seed weight (g)	6.17	13.54	9.60	17.40	17.40	96.66	3.44	35.84
Seed yield per plant (g)	5.85	14.49	8.84	19.48	19.48	97.12	3.54	40.13

Umbels per plant (35.24) showed highest phenotypic coefficient of variation followed by Nodes per plant (26.84), branches per plant (23.47), fruits per umbel (21.39), plant height (9.04 cm) and lowest phenotypic coefficient of variation was observed for days to 50% flowering (2.46). While, highest genotypic coefficient of variation was observed for umbels per plant (35.23) followed by nodes per plant (26.87), branches per plant (23.47), fruits per umbel (19.98) and lowest phenotypic coefficient of variation was observed for days to 50% flowering (2.46) and followed by plant height (9.04). Umbels per plant showed highest genotypic coefficient of variation, high heritability %, high genetic advance and high genetic advance in per cent of mean. The similar, results were reported by Srivastava *et al.* (2000) [10], Rajput and Singh (2003) [5] and Singh *et al.* (2005). Heritability estimates assess the amount of transmissible genetic variability to the total variability and happens to most important basic factor that determines the genetic improvement or response to selection. However, the degree of improvement attained through selection is not only depending upon heritability but also on the amount genetic variation present in breeding population and extent of the selection pressure applied by the breeder. The estimates of heritability in broad sense were higher for all the characters. High values of heritability suggest the major role of genotypic constitution in the expression of character. In the present study, high heritability was expressed for Plant height (99.00 cm), nodes per plant (98.12 cm) followed by seed yield per plant (97.12 cm), 1000 seed weight (96.66 cm), umbel diameter (95.12 cm), umbellets per umbel (93.55 cm), fruits per umbellets (90.42 cm), Branches per plant (88.75 cm), fruits per umbel (87.00 cm) and days to 50% flowering (75.00 cm). None of the characters showed low estimate of heritability in broad sense present studies are in agreement with those of Tripathi *et al.* (2000) [10], Rajput and Singh (2003) [5], Singh *et al.* (2006) [6] and Singh *et al.* (2008) [7].

The highest genetic advance was expressed for plant height (24.19) followed by umbels per plant (15.70), fruits per umbel (14.21), nodes per plant (5.40), days to 50% flowering (4.59), seed yield per plant (3.54), branches per plant (3.45), 1000 seed weight (3.44), umbellets per umbel (2.00) and fruits per umbellets (1.58). The findings of present study are in agreement with those of Rajput and Singh (2003) [5] and Singh *et al.* (2008) [7].

Genetic advance in per cent of mean was highest in case of umbels per plant (72.59), nodes per plant (55.36), branches per plant (48.35), umbels per plant (38.05), seed yield per plant (40.13) followed by fruits per umbel (38.43) test weight (35.84) and umbellets per umbel (33.0). The findings of present study are in agreement with those of Rajput and Singh (2003) [5] and Singh *et al.* (2008) [7].

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