Research Article

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CYTOLOGICAL ASSESSMENT OF SEED PRODUCING CULTIVAR OF *CORIANDRUM SATIVUM* L. (APIACEAE)

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ABSTRACT

Mitotic and meiotic chromosome studies are performed in *Coriandrum sativum* L. (Apiaceae) cultivar Co. 3, selection from Acc. No. 695 IARI germplasm, with an objective of cytological indexing for germplasm assessment and genetic exploration. Karyotype details and meiotic (2n=22) chromosome configurations are discussed.

Keywords: *Coriandrum sativum*, Karyotype, Meiosis, Cytological cataloguing

INTRODUCTION

Coriandrum sativum L. (family: Apiaceae, commonly known as coriander) yields spice of commerce apart from possessing ethnobotanical (treatment of diabetic disorder) and medicinal (carminative, diuretic, control of nausea, stomach disorder among others) uses[1,2]. The species is annual, self-pollinated and commercially cultivated in few states (Andhra Pradesh, Rajasthan, Tamil Nadu) of India, and therefore it is important to keep the crop under sustainable cultivation as it is classified under the major spice of India[3]. For the purpose, it is noteworthy to catalogue the germplasm(s) under study. Present communication describes cytological indexing (assessment of mitotic and meiotic chromosomes) of a cultivar of *C. sativum.* Similar study is also performed earlier in *Indigofera tinctoria* L.[4].

MATERIALS AND METHODS

Germplasm

Co. 3 cultivar of *Coriandrum sativum* L. (family: Apiaceae), pureline selection from Acc. No. 695 IARI, is used as germplasm source. The cultivar was obtained from Pulses and Oil Seeds Research Station, Department of Agriculture, Govt. of West Bengal, Berhampore, Murshidabad. The germplasm was procured as a seed yielding cultivar.

Karyotype Analysis

Seeds of *C. sativum* were allowed to germinate in Petri plates (22º ± 1º C) lined with moist filter papers. Germinating roots (2-3 mm in length) were cut and pretreated in 0.05% aqueous colchicine solution for a period of 3 h at room temperature (22º ± 1º C). Pretreated roots were fixed in acetic alcohol (1:3 v/v) for overnight, washed in distilled water and stained in 1 N HCl-orcein mixture (9:2) for 3 h. The root tips were cut and squashed in 45% acetic acid on a glass slide. Three properly and uniformly condensed metaphase plates were selected for studying karyotyping details (average data presented) using the microscope Leitz LABORLUX S with CCD camera (Leica EC3) attachment (software- Leica Application Suit, Version 2.1.0, LASEZ).

The chromosomes were designated as metacentric (m), sub-metacentric (sm) and sub-acrocentric (sac) as suggested earlier by Hirahara and Tatuno[5]. On the basis of chromosome length (very long: L^{+}−≥ 6.0 µm; long: L−4.0 µm to 5.99 µm; medium: M−< 4.0 µm), centromeric position and presence of satellite, the chromosomes were morphologically graded: type A: very long sub-acrocentric chromosomes with satellites which are associated with the short arms, type B_1−B_4: long metacentric chromosomes, type C_1−C_4: long sub-metacentric chromosomes and type D_1−D_2: medium metacentric chromosomes. Total haploid chromatin length, arm ratio, relative length, TF% (relative proportion of short arm in the total chromatin length) and S% (relative length of shortest chromosome compared to longest) were also studied. Karyomorphological data were used to compute karyotype formula.

Meiotic Study

Inflorescences from 3 randomly selected coriander plants (each year for 3 consecutive years**)** were scored for the purpose. The umbels were fixed between 6 am to 7 am in acetic alcohol (1:3 v/v) for overnight and stored under refrigeration (16 º ± 1º C) in 70% alcohol. Anther squash preparations were performed on a glass slide. Pollen Mother Cells (PMCs) and pollen grain were stained in 2% aceto-carmine solution. Uniformly stained pollen grain were considered fertile. Data analyses were made from well scattered meiocytes at metaphase I (MI), anaphase I (AI) and anaphase II (AII).

Photomicrographs of mitotic and meiotic chromosome plates were taken from temporary preparations and subsequently magnified.

RESULTS AND DISCUSSION

Karyomorphological data are presented in Table 1. Karyotype (Figure 1:A-B) documents 4 morphological distinct chromosome types (2n = 22: $*2A^{L+}_{sac}$ + $8B^{L}_{m}$ +$8C^{L}_{sm}$ + $4D^{M}_{m}$). The karyotype shows preponderance of metacentric chromosomes (6 pairs; 4 long and 2 medium sized) with F% ranging from 40.40% to 47.66%. Four pairs of chromosomes are with sub-metacentric

constrictions. A pair of very long chromosomes with sub-acrocentric primary constrictions is with satellites. Total haploid chromatin length and S% in the cultivar are ascertained to be 49.17µm ± 1.67 and 55.78% respectively. TF% (37.79%) suggests that the karyotype is asymmetric in nature.

Distinct karyotype variations are reported in different cultivars of *C. sativum*. Baijal and Kaul[6] suggest 7 chromosome types of which 3 pairs are with satellites. Hore[7] describes 4-6 chromosome types (A-F) in different varieties of coriander; while, Subramanian[8] documents 4 types. Das and Mallick[9] demonstrate a new karyotype with 7 chromosome types with one or two secondary constrictions. Sengupta[10] reports 5 chromosome types in NP (D) 95 and TNP (D) 92 varieties of coriander. Hore[7] opine that the rearrangement of genes within the chromosome possibly played an important role in karyotype variation in different cultivars of *C. sativum*. Das and Mallick[9] indicate that structural changes of the chromosomes as well as changes of repetitive DNA sequences played an important role in karyotype variation in coriander germplasms. Thus, existence of such karyotype variations among the germplasms of coriander triggers the essentiality of proper cytological cataloguing for germplasm maintenance for future exploration.

Meiotic analyses reveal 2n = 22 chromosomes always (Figure 2:A-F). Average chromosome association per cell at MI is recorded to be 10.86II + 0.28I (296 PMCs analyzed) with predominance of 11II formation (89.87%) per cell. Apart from 11II, other associations studied at MI are 10II + 2I (8.45%), 9II + 4I (0.68%), 8II + 6I (0.34%), 7II + 8I (0.34%), 6II + 10I (0.34%). The univalents are mostly found to present in close proximity to each other and often show residual connection between them. AI (212 cells scored) and AII (295 cells observed) cells are found to be cytologically balanced (Figure 2:E-F). Pollen fertility in the cultivar ranges between 94.20% (496 pollen grain scored) and 96.29% (512 pollen grain assessed).

Meiotic chromosome number noted is in conformity to earlier reports[6,10]. Baijal and Kaul[6] suggests that the present chromosome number (n = 11) of the species is the outcome of chromosome elimination mechanism as was indicated by Darlington[11].

The formation of regular bivalents and the absence of heterozygosity in the cultivar possibly indicate homozygosity for different translocations, which plays significant role in cytological variations within the cultivars.

Table 1: Karyomorphological details of *C. sativum*

Chromosome types	Somatic chromosome Pair	Chromosome length (µm)				Arm ratio LA/SA	Relative length (%)	F (%)	Nature of primary constriction
		Long arm (LA)	Short arm (SA)	Secondary constriction	Total				
A	A_1A_1	3.57	1.37	1.40	6.34	2.61:1.00	100.0	27.73	Sub-acrocentric
B	B_1B_1	2.46	2.24		4.70	1.10:1.00	74.13	47.66	metacentric
C	C_1C_1	2.94	1.76		4.70	1.67:1.00	74.13	37.45	Sub-metacentric
B	B_2B_2	2.69	1.84		4.53	1.46:1.00	71.45	40.62	metacentric
C	C_2C_2	2.90	1.56		4.46	1.86:1.00	70.35	34.99	Sub-metacentric
B	B_3B_3	2.34	2.08		4.42	1.13:1.00	69.72	47.06	metacentric
B	B_4B_4	2.39	1.86		4.25	1.29:1.00	67.04	43.77	metacentric
C	C_3C_3	2.62	1.42		4.04	1.85:1.00	63.72	35.15	Sub-metacentric
C	C_4C_4	2.69	1.32		4.01	2.04:1.00	63.25	32.92	Sub-metacentric
D	D_1D_1	2.36	1.60		3.96	1.48:1.00	62.46	40.40	metacentric
D	D_2D_2	2.23	1.53		3.76	1.46:1.00	59.31	40.69	metacentric

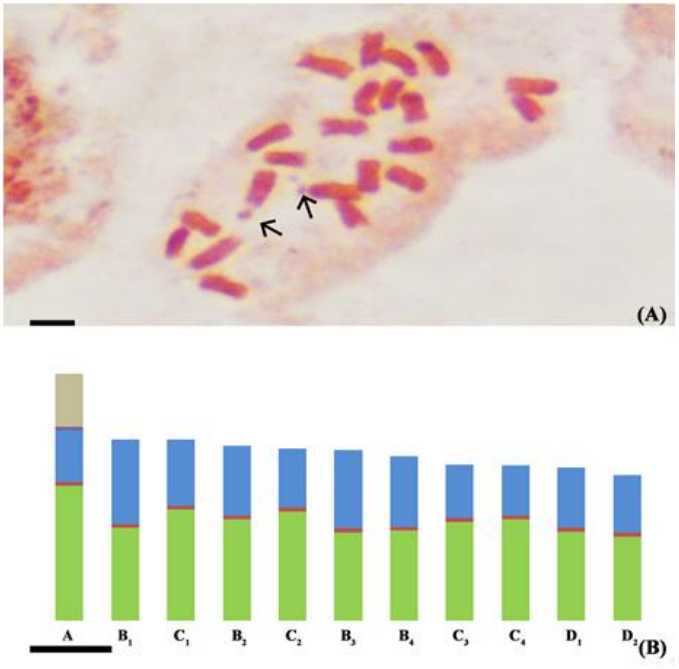

Figure 1: Metaphase chromosomes of *C. sativum* (2n=22) (A) Karyomorphology (secondary constriction marked (→); (B) Idiogram. Scale bar = 2.0µm

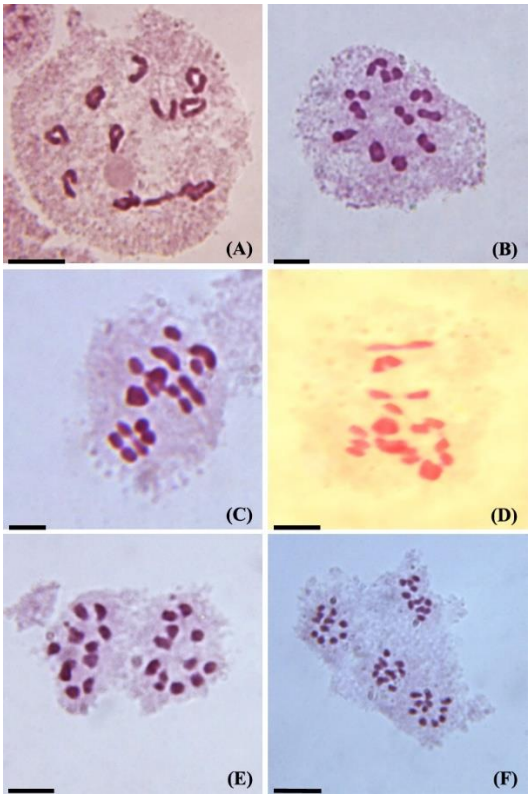

Figure 2: Meiotic configurations in *C. sativum* (A) Diplotene with 11II; (B) 11II at MI; (C) 10II + 2I at MI; (D) 6II + 10I at MI; (E) AI with equal (11/11) separation of chromosomes; (F) Cytologically balanced AII. Scale bar = 10µm

CONCLUSION

Mitotic and meiotic chromosome studies in the cultivar provide wealth of information, which can be helpful for proper cytological indexing. Such cataloguing is significant for maintenance of germplasm as important genetic resources for further exploration and crop improvement.

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REFERENCES

1. Msaada K, Hosni K, Taarit MB, Chahed T, Kchouk ME, Marzouk B. Changes on Essential Oil Composition of Coriander (*Coriandrum sativum* L.) Fruit during three stages of maturity. 2007; 102:1131−1134.
2. Rajeshwari U, Andallu B. Medicinal benefits of coriander (*Coriandrum sativum* L). Spatula DD. 2011; 1:51−58.
3. Pruthi JS. Spices and Condiments. National Book Trust, India. 1998; 109−144.
4. Ghosh B, Mallick T, Ghosh A, Datta AK, Pramanik A. Taxonomical, Anatomical, Cytological and Palynological Assessment of a Germplasm of *Indigofera tinctoria* L. (Fabaceae): An Ayurvedic Plant. Int J Res Ayurveda Pharm 2016; 7:90−95.
5. Hirahara S, Tatuno S. Cytological Studies on *Narcisus*. I. Karyotype and Nucleolinus of *Narcissus jonquilla*. Cytologia 1967; 32:553−559.
6. Baijal SK, Kaul BK. Karyomorphological Studies in *Coriandrum sativum* and *Cuminum* L. Cytologia 1973; 38:211−217.
7. Hore A. Study of the Structure and Behaviour of Chromosomes of Different Agricultural Strains of *Coriandrum sativum* (Coriander). Caryologia 1977; 30:445−459.
8. Subramanian D. Cytotaxonomical Studies in South Indian Apiaceae. Cytologia 1986; 51:479−488.
9. Das A, Mallick R. Variation in 4C DNA Content and Chromosome Characteristics in Different Varieties of *Coriandrum sativum* L. Cytologia 1989; 54:609−616.
10. Sengupta K. Studies on the Cytogenetical Aspects of Induced Mutation and Autotetraploidy of Coriander (*Coriandrum sativum* L.) 2001; Ph.D. thesis 92− 93.
11. Darlington CD. Recent advances in cytology. 2nd ed. Philadelphia: P. Blakiston's son and Co.; 1937.

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