Indian J. Genet., **63**(4): 361-362 (2003)

Short Communication

Chromosomal studies in four seed spices of Umbelliferae

Rita Paul and Animesh Kumar Datta

Department of Botany, University of Kalyani, Kalyani 741 235

(Received: June 2003; Revised: November 2003; Accepted: November 2003)

Seed spices of Umbelliferae namely, *Apium graveolens* L. (celery), *Cuminum cyminum* L. (cumin), *Foeniculum vulgare* Mill. (fennel) and *Trachyospermum amni* L. (ajowan) are economically important as they are consumed and exported from India as raw materials as well as value added products. The present investigations were carried out to gather information on the status of karyotype and chromosome behaviour in the above mentioned four seed spice species.

For karyotype analysis, seeds of celery, cumin, fennel and ajowan (Nadia local cultivars obtained from Zonal Adaptive Govt. Research Station, Krishnanagar, West Bengal) were presoaked in distilled water for 12h and allowed to germinate (18°C ± 1°C) in petriplates lined with moist filter papers. Healthy roots of proper size (2-3mm) from the seed spices were collected (12 pm to 12.30 pm) and pretreated with supersaturated aqueous solution of para-dichlorobenzene containing tinge of aesculin (initially at 0-4°C for 10 min and finally at 16°C ± 1°C for 3-4 h), fixed in 1: 3 propiono-alcohol (v/v) for overnight and stained in 2% orcein-1(N) HC1 mixture (9:1) for 2-3 h. Root tips were squashed in 45% acetic acid and observed under the microscope.

Following Hirahara and Tatuno the chromosomes were classified into four categories *viz.*, metacentric (F%: 40.0-50.0), submetacentric (F%: 30.0-39.9), subtelocentric (F%: 20.0-29.9) and telocentric (F%: 1.0-19.9) [1]. Total haploid chromatin length, TF% (proportion of short arms in the total chromatin length), and S% (relative length of shortest chromosomes compared to the longest) were also studied. On the basis of chromosome length (long: > 3.75µm, medium: 2.5µm to 3.75µm, small: > 1.5µm to < 2.5µm and very small: ≤ 1.5µm), F% and presence or absence of secondary constriction the chromosomes in the species were morphologically classified into following types: type A-long submetacentric chromosomes with satellites; type B-long subtelocentric chromosomes, type C-medium metacentric chromosomes with satellites; type C′-medium metacentric chromosomes; type D-medium submetacentric chromosomes with satellites; type D′-medium submetacentric chromosomes; type E-medium subtelocentric chromosomes with satellites; type E′-medium subtelocentric chromosomes; type F-small metacentric chromosomes; type G-small submetacentric chromosomes; type H-small subtelocentric chromosomes; type I-small telocentric chromosomes; type J-very small metacentric chromosomes; type K-very small subtmetacentric chromosomes.

Karyotype analysis revealed 6 (*Apium graveolens*: 2n = 22 = 2C + 10C′ + 4D + 2D′ + 2J + 2K; *Cuminum cyminum* : 2n = 14 = 2D′ + 2E + 4E′ + 2G + 2H + 2I and *Trachyospermum amni* : 2n = 18 = 2A + 2B + 2C + 4C′ + 2D′ + 6E′) and 4 (*Foeniculum vulgare* : 2n = 22 = 8C′ + 4D + 2D′ + 8F) morphologically distinct chromosome types in the species. Chromosome number noted in the species are in confirmity to earlier reports [2,3]. However, a South Indian cytotype of cumin was found to possess 2n = 18 chromosomes with 2 pair of chromosomes with satellites [4] as against 1 pair in 14 somatic chromosomes observed in present investigation. Baijal and Kaul [3] reported 3 pair of satellites in cumin including a pair associated to long arm of the chromosomes. In the present investigation, satellites in all the cases were associated to short arms. Metacentric chromosomes were prevalent in *Apium graveolens* and *Foeniculum vulgare*; while, a telocentric pair was noted in *Cuminum cyminum*. Characteristically two long and two short pair of chromosomes could be marked in *Trachyospermum amni* and *Apium graveolens* respectively. Total haploid chromatin length, TF% and S% were observed to be 30.41 µm ± 2.30, 42.03 and 37.60 in *Apium graveolens*; 19.04 µm ± 1.61, 26.63 and 63.98 in *Cuminum cyminum*; 29.12µm ± 2.73, 39.96 and 69.59 in *Foeniculum vulgare* and 32.45 µm ± 3.52, 33.04 and 62.92 in *Trachyospermum amni*.

Meiotic analysis (meiosis performed from anther squashes in 1% propionocarmine stain after fixation of flower buds in 1:3 propiono-alcohol between 6.30 am

Table 1. Karyotypic details of four seed spices species of Umbelliferae

Spice species	Chromosome pair										
	1	2	3	4	5	6	7	8	9	10	11
Apium graveolens	3.75*	3.22	3.19	3.06*	3.06	2.97	2.81*	2.81	2.63	1.50	1.41
(2n = 22)	36.00	37.89	45.14	36.93	49.02	45.45	40.21	44.48	44.11	46.00	39.72
	sm	sm	m	sm	m	m	m	m	m	m	sm
Cuminum cyminum	3.22	3.13	3.10*	2.75	2.47	2.31	2.06				
(2n = 14)	24.22	30.03	28.39	27.27	16.60	24.24	36.41				
	st	sm	st	st	t	st	sm				
Foeniculum vulgare	3.19	3.00	2.97*	2.78	2.66*	2.66	2.57	2.38	2.35	2.35	2.22
(2n = 22)	30.35	41.67	35.69	43.88	33.08	46.99	45.14	40.76	42.55	40.00	40.99
	sm	m	sm	m	sm	m	m	m	m	m	m
Trachyospermum ammi	4.72*	4.44	3.75	3.50	3.44	3.38	3.25*	3.00	2.97		
(2n = 18)	31.14	21.17	48.27	28.57	38.08	25.15	40.31	41.67	26.26		
	sm	st	m	st	sm	st	m	m	st		

First line : absolute length in µm; second line : F value in per cent; third line : centromeric nature of the chromosomes (m = metacentric, sm = submetacentric, st = subtelocentric and t = telocentric); *Chromosomes with satellites

Table 2. Meiotic analysis in four seed spice species of Umbelliferae

Species	No. of diplotene cells scored	Mean no. of chiasma at diplotene	No. of MI cells score	Mean chromo some/cell	Bivalent configuration at MI				Mean no. of chiasma at MI	Chiasma terminaliz ation coeffi- cient	Total AI cells scored	Equal separa tion at AI (%)
				Univalent	Bivalent	Ring		Rod				
						Range	Mean	Range	Mean				
A. graveolens	28	12.9±0.41	53	0.15±0.07	10.9±0.04	0-6	0.98±0.17	4-11	9.9±0.18	11.9±0.16	0.93	38	100.0
C. cyminum	16	09.8±0.54	17	2.35±0.30	05.8±0.15	1-3	0.59±0.20	3-6	5.2±0.21	06.4±0.29	0.66	20	100.0
F. vulgare	30	14.0±0.63	30	0.62±0.27	10.7±0.13	0-5	1.47±0.28	3-11	9.2±0.18	12.2±0.25	0.87	80	095.0
T. amni	20	11.0±0.22	43	0.23±0.18	8.9±0.06	0-4	1.07±0.18	5-9	7.8±0.17	10.0±0.20	0.90	22	100.0

and 7.30 am during late February and early March from 3-5 randomly selected plants for each species) revealed mostly bivalent and rarely univalent formation (Table 2, Figs. 1A-1D). Mean association of chromosomes per cell at MI has been 10.90II+0.15I in celery (n = 11), 5.80II+2.35I in cumin (n = 7), 10.70II+0.62I in fennel (n = 11) and 8.90II+0.23I in ajowan (n = 9). Preponderance of rod bivalents was noted in all species. Greater reduction in chiasma frequencies from diplotene to metaphase I in cumin has resulted in relatively low chiasma terminalization coefficient as compared to other three species. Anaphase I (only 5% cells of fennel showed unequal segregation of chromosomes in the form of 9-2-11 and 10-12) and later stages of meiosis were normal in the species. Pollen fertility (mature anthers were smeared in 1% propionocarmine and fully stained pollen grains were considered fertile) was 91.6% in *Apium graveolens*, 84.8% in *Cuminum cyminum* 98.6% in *Foeniculum vulgare* and 99.6% in *Trachyospermum amni.*

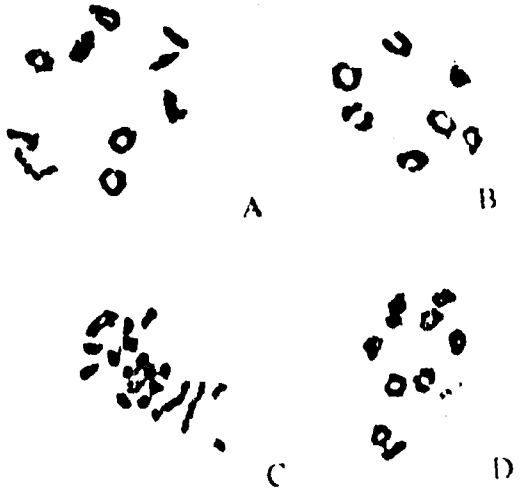

Fig. 1A-D. Meiotic chromosomes. (A) diplotene showing 11 bivalents in *Apium graveolens*; (B) seven bivalents at diplotene of *Cuminum cyminum*; (C) 9II+4I at MI of *Foeniculum vulgare*; (D) diplotne showing 9 bivalents in *Trachyospermum amni*

References

1. **Hirahara S. and Tatuno S.** 1967. Cytological studies on *Narcissus* I. Karyotype and nucleolinus of *Narcissus jonquilla*. Cytologia, **32**: 553-559.

2. **Bell C. R. and Constance L.** 1957. Chromosome numbers in Umbelliferae I. Amer. J. Bot., **44**: 565-572.

3. **Baljal S. K. and Kaul B. K.** 1973. Karyomorphological studies in *Coriandrum sativum* L. and *Cuminum cyminum* L. Cytologia, **38**: 211-217.

4. **Subramanian D.** 1986. Cytotaxonomical studies in South Indian Apiaceae. Cytologia, **51**: 479-488.