Autotetraploidy in *Fimbristylis falcata* (Vahl) Kunth (Cyperaceae)

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ABSTRACT

The karyotype and meiosis in a tetraploid population of *Fimbristylis falcata* (Vahl) Kunth ($2n = 44$) have been studied. The chromosomal data reveal the presence of four essentially similar genomes. In the light of available data it is concluded that the taxon is a natural autotetraploid.

1. INTRODUCTION

Fimbristylis falcata is a rhizomatous sedge, common in hilly areas throughout India. Previous chromosome counts reveal that there are two chromosomal races in this species, one with $2n = 22$ (Ref. 1) and the other with $2n = 44$ (Ref. 2). The present investigation deals with the karyotype and meiosis in a population ($2n = 44$) of *F. falcata* (Vahl) Kunth (*F. junci-formis* Kunth).

2. MATERIAL AND METHODS

Material was collected from the hilltops near Bannerghatta (Bangalore District). Somatic chromosomes were studied from mitosis in root tips following the method described by Tjio and Levan (Ref. 3). Several metaphase plates were examined, and the one with well spread chromosomes was selected for karyotype analysis. The chromosomes of a single genome are reproduced in the idiogram. Each chromosome in the idiogram represents four homologous chromosomes of the somatic complement. For meiotic study young spikelets were fixed in 1:3 acetic-alcohol for 24 hours and anthers were squashed in acetocarmine.

3. OBSERVATIONS

The somatic complement has 44 chromosomes (figures 1-3). The length of chromosomes in the somatic complement ranges from $1.4 \mu\text{m}$ to $2.1 \mu\text{m}$.

The total length of the diploid complement is $74.12 \mu\text{m}$. There are 12 pairs of chromosomes with median centromeres, and 10 pairs with submedian centromeres of which the longest 2 pairs have satellites in the long arms. The details of karyotype are given in table 1.

During meiosis the pollen mother cells show variable number of quadri-valents, trivalents, bivalents and univalents at diakinesis and metaphase I (figures 4-7). The frequency of chromosome associations at diakinesis is given in table 2. The number of quadrivalents in each pollen mother cell

Table 1. Measurements of somatic chromosomes in *Fimbristylis falcata*

Chromosome pairs	Chromosome length (μm)			Relative length of a pair (%)	Arm ratio (s/l)	Centromere
	l.a	s.a	total length			
1, 2	$0.35 + 1.05 + 0.70 = 2.10$ (SAT)			5.66	0.50	sm
3, 4	$1.40 + 0.70 = 2.10$			5.66	0.50	sm
5, 6	$1.05 + 0.70 = 1.75$			4.72	0.66	m
7, 8	$1.05 + 0.70 = 1.75$			4.72	0.66	m
9, 10	$1.23 + 0.52 = 1.75$			4.72	0.42	sm
11, 12	$0.87 + 0.87 = 1.74$			4.70	1.00	M
13, 14	$1.05 + 0.52 = 1.57$			4.24	0.49	sm
15, 16	$1.05 + 0.52 = 1.57$			4.24	0.49	sm
17, 18	$0.70 + 0.70 = 1.40$			3.78	1.00	M
19, 20	$0.70 + 0.70 = 1.40$			3.78	1.00	M
21, 22	$0.70 + 0.70 = 1.40$			3.78	1.00	M

Table 2. Frequency of chromosome associations at diakinesis in *Fimbristylis falcata*

Chromosome configurations				No of cells observed
Quadrivalents	Trivalents	Bivalents	Univalents	
11	..	..	..	3
10	..	2	..	3
9	..	4	..	40
9	1	2	1	3
8	..	6	..	21
7	..	8	..	2
7	1	6	1	2
6	..	10	..	4
6	..	6	8	1
3	..	16	..	1
Mean	8.48	0.06	4.80	0.16

Figures 1 and 2. *Fimbristylis falcata*. 1 and 1a. somatic chromosomes; 2. idiogram of a single genome.

Figures 3-8. *Fimbristylis falcata*. 3. somatic chromosomes (from a different metaphase plate). 4. diakinesis with $10_{IV} + 2_{II}$. 5. diakinesis with $9_{IV} + 4_{II}$. 6. MI with $10_{IV} + 2_{II}$. 7. diakinesis with $8_{IV} + 1_{III} + 4_{II} + 1_{I}$. 8. pollen mitosis.

(facing page 23)

ranges from 3 to 11, 9 being the most frequent. Besides quadrivalents, bivalents and occasionally, in addition to bivalents, trivalent and/or univalents are observed. Invariably one quadrivalent or 2 bivalents are associated with the nucleolus at diakinesis. There is equal distribution of chromosomes at both first and second divisions. Pollen mitosis is normal (figure 8). Pollen fertility is 90 per cent.

4. DISCUSSION

The present population of *Fimbristylis falcata* with $2n = 44$ is a tetraploid on the basic number $x = 11$. The other species of *Fimbristylis* conforming to this basic number are *F. sericea* ($n = 22$) (Ref. 4) and *F. paupercula* ($2n = 44$) (Refs. 5 and 6). The karyotype data in the present taxon reveal the high degree of similarity among the chromosomes in the somatic complement with particular reference to SAT-chromosomes, arm ratio and relative length indicating the presence of 4 essentially similar sets of 11 chromosomes (table 1). The behaviour of chromosomes at meiosis with all the chromosomes of a cell grouped into 11 quadrivalents provides additional evidence in support of the perfect homology of the 4 genomes. The aforesaid chromosomal data strongly suggest the autotetraploid nature of this taxon.

The diploid population of *Fimbristylis falcata* reported from Eastern India (Ref. 1) appears to be the progenitor of the present taxon. This viewpoint is supported by the similarity with respect to the relative length and chromosome types in the karyotypes of these populations. Since both the populations have been treated as conspecific by the taxonomists, it is inferred that the differences in chromosome number are not manifested in morphological differentiation.

The autopolyploids are considered to be usually ephemeral and of no evolutionary significance (Ref. 7). However, Müntzing (Ref. 8) pointed out that in autopolyploidy the vigour and fertility are greatly improved if the starting material is heterozygous. In addition, these autopolyploids may secondarily give rise to typical allopolyploids through hybridization with autopolyploids of other diploid species. Therefore, the evolutionary significance of autopolyploid changes within a species is perhaps greater than is generally assumed.

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