Indian J. Genet., **56** (4): 406–411 (1996)

CYTOLOGY OF SOME MOSSES FROM THE WESTERN HIMALAYAS

G. BASSI* AND S. S. KUMAR

Department of Botany, Panjab University, Chandigarh

(Received: October 16, 1990; accepted: January 16, 1996)

ABSTRACT

The investigation deals with meiotic studies of 10 West Himalayan moss taxa belonging to 7 genera.

Key words: Polytrichaceae, Dicranaceae, Grimmiaceae, Funariaceae, aneuploidy.

Cytological studies were made for the first time in *Polytrichastrum emodii, Pogonatum thomsonii, Campylopus ericoides, Racomitrium heterostichum* ssp. *heterostichum, R. himalayanum* and *Funaria wijikii*. The present investigation in *Physcomitrium coorgensis, P. japonicum, Funaria nutans* and *Entosthodon wallichii*, are at variance with the earlier reports [1, 2].

MATERIALS AND METHODS

The plants studied were collected by the first author from different localities of Dharamsala from August to October in 1986 and 1987. For somatic studies, regenerants were raised in the laboratory in winter months (October–March). The meristematic tips of these regenerants were pretreated in 0.003 M aqueous solution of 8-hydroxyquinoline for 2–3 h at laboratory temperature and then fixed in 1:3 acetic acid : alcohol for 20–24 h and later hydrolysed in 1 N HCl for 10–12 min at 60°C. After washing in distilled water, the material was immersed in Fuelgen stain and kept in dark for about an hour. The stained apical portion was dissected in 45% acetic acid on a clean glass slide and squashed in 2% acetocarmine. For meiotic studies the smear preparations from sporogenous tissue were obtained using 2% acetocarmine. The slides were made permanent in Euparol. Unless stated otherwise, the photomicrographs were taken at a uniform magnification of x 1800. The voucher specimens have been deposited in the herbarium, Department of Botany, Panjab University, Chandigarh.

*Present address: Dr. Geeta Bassi, Plant Biotechnology Centre, Department of Plant Breeding, Punjab Agricultural University, Ludhiana 141 004.

OBSERVATIONS AND RESULTS

ORDER: POLYTRICHALES
FAMILY: POLYTRICHACEAE

Polytrichastrum emodii Smith, n = 7.

The examined material was collected from Dharamsala (Triund, alt. 2800 m, on wet soil, *PAN 3978*).

Of the 7 bivalents observed at metaphase I, one was relatively larger, four were showing a tendency for precocious separation and one bivalent was ring-shaped with two chiasmata. Meiosis was regular, resulting in normal tetrads.

Pogonatum thomsonii (Mitt.) Jaeg., n = 7(2).

The two populations studied were gathered from Dharamsala (Triund and Mcleodganj, on wet soil, alt. 2800 m, *PAN 3843* and alt. 2200 m, *PAN 3982*).

The seven-chromosome complement observed at first metaphase and somatic metaphase of both the populations included one distinctly large chromosome. None of the members of the set qualified as m-type and one of the bivalents showed precocious disjunction. The R.L. and F% values of the seven somatic chromosomes are given in Table 1.

Table 1. Measurements of somatic chromosomes (at metaphase) of *Pogonatum thomsonii* (No. of cells studied = 30)

Chromosome	Length in μm			R.L.*	F%**
	short arm	long arm	total length		
1	3.35 ± 0.01	3.63 ± 0.01	6.98	21.63	47.99
2	2.36 ± 0.01	4.67 ± 0.02	7.04	21.82	33.52
3	1.76 ± 0.02	3.30 ± 0.01	5.06	15.68	34.78
4	—	—	4.89	15.15	—
5	—	—	2.75	8.52	—
6	—	—	2.75	8.52	—
7	—	—	2.75	8.52	—

*R.L. (relative length) = $\frac{\text{Total length of the chromosome}}{\text{Total chromosome length in the set}} \times 100$

**F% (form per cent) = $\frac{\text{Short arm of the chromosome}}{\text{Total length of the chromosome}} \times 100$

ORDER: DICRANALES
FAMILY: DICRANACEAE
Subfamily: Campylopodioideae

Campylopus ericoides (Griff.) Jaeg., n = 12.

The cytological study of this previously uninvestigated species was made in a collection from Dharamsala (Mcleodganj, alt. 2000 m, on clayey soil, *PAN 3846*).

Unlike other dicranaceous taxa, somatic chromosomes in this species had good spread. The R.L. and F% values of the twelve fastly stained chromosomes observed at metaphase are given in Table 2.

Table 2. Measurements of somatic chromosomes (at metaphase) of *Campylopus ericoides* (No. of cells studied = 30)

Chromosome	Length in μm			R.L.*	F%**
	short arm	long arm	total length		
1	0.88 ± 0.01	5.39 ± 0.01	6.27	17.55	14.03
2	1.70 ± 0.01	3.46 ± 0.02	5.16	14.44	32.94
3	0.60 ± 0.01	2.80 ± 0.01	3.40	9.52	17.64
4	0.66 ± 0.01	2.25 ± 0.01	2.91	8.14	22.68
5	0.55 ± 0.00	2.14 ± 0.01	2.69	7.53	202.44
6	1.21 ± 0.01	1.43 ± 0.00	2.64	7.39	45.83
7	1.15 ± 0.02	1.48 ± 0.01	2.63	7.36	43.72
8	0.49 ± 0.02	1.70 ± 0.01	2.19	6.13	22.37
9	—	—	2.14	5.99	—
10	—	—	2.14	5.99	—
11	0.55 ± 0.01	1.32 ± 0.01	1.87	5.23	29.41
12	—	—	1.59	4.45	—

*See Table 1 for explanations.

ORDER: GRIMMIALES
FAMILY: GRIMMIACEAE

Racomitrium heterostichum ssp. *heterostichum* Chop., n = 13.

This taxon occurs at over 250 m altitude in the Western Himalaya. The present material was collected from Dharamsala (Triund forest, on shaded rocks, alt. 2800 m, *PAN 4022*).

The meiotic complement of this cytologically unattended taxon was found to include 13 chromosomes. On the basis of their size, the bivalents could be graded as: 6 large, 6 medium and 1 small sized. The smallest bivalent showed a tendency towards precocious disjunction. Compared with other species, the sporocytes were relatively smaller. Meiosis was regular with normal tetrads.

R. himalayanum (Mitt.) Jaeg., n = 13.

This cytologically uninvestigated species was gathered from Dharamsala (Triund forest, alt. 2842 m, on exposed rocks, *PAN 4023*).

The 13-chromosome complement included 1 faintly stained h-type bivalent which tended to separate prematurely. *Recomitrium* includes 77 species of which only 11 have been studied cytologically. The prevailing chromosome numbers in the genus are n = 12 (8 taxa), n = 13 (8 taxa) and n = 14 (7 taxa) [1]. On the basis of the available data it seems that aneuploidy is an important evolutionary mechanism operating in these rock inhabiting forms.

ORDER: FUNARIALES
FAMILY: FUNARIACEAE

Physcomitrium coorgensis Broth. Rec., n = 52.

The plants of this material were collected from Dharamsala (Triund, alt. 2842 m, on wet soil, *PAN 4028*).

The meiotic count of n = 52 was established after examining numerous dividing sporocytes as the bivalents showed stickiness. The bivalents were darkly stained and showed synchronous disjunction and distribution resulting in normal tetrads. Kumar and Anand [2] reported n = 26 in some other West Himalayan population of this species.

P. japonicum (Hedw.) Mitt., n = 52.

This material was collected from Sunder Nagar (Gangal Khudd, alt. 1050 m, on soil, *PAN 3924*).

The chromosome count n = 52 disagrees with the previous reports of n = 18 [3], n = 12 [4], and n = 26 [2]. The bivalents were sticky, some of them tended to lie in pairs, indicating homeologous nature of some members of the set, and possibly, autoploid nature of this taxon. The regularity in meiosis indicates that the polyploid form has established during the course of evolution.

The genus *Physcomitrium* embraces 86 species of which only 9 (including an unidentified species [3, 5] were investigated cytologically. An array of chromosome numbers (n = 9, 12,18, 24, 25, 26, 27, 36, 45, 52, 54, 72) recorded in this genus [1] indicates the role of polyploidy and aneuploidy in the evolution and speciation of *Physcomitrium*. The available data suggest that this genus is based on x = 9. The numbers n = 3, 6 and 8 [1] appear to be dubious counts requiring confirmation.

Funaria nutans (Mitt.) Broth., n = 42.

This taxon was found growing on the damp floor of dense forest in Dharamsala (Mcleodganj, alt. 1900 m, *PAN 3854*).

The present count n = 42 differs from earlier reports of n = 26 [4, 6] based on Darjeeling and Mussoorie populations of this species. The bivalents were sticky and difficult to spread at first metaphase. Chromosomes showed little variation in size.

F. wijikii (Broth.) Chop., n = 42.

The material, collected from Srinagar (on way to Chasma-e-Shahi, alt. 1800 m, *PAN 4077*), was found growing on wet soil along flowing water.

The chromosome number of this species was not reported earlier. Metaphase I showed 42 deeply stained bivalents, two of which were relatively larger, and the remaining bivalents were sticky and tended to lie in pairs.

Cytologically, the genus *Funaria* is quite confusing. Only 14 out of the 108 known species of the genus have been studied cytologically. The chromosome numbers in the investigated species are: n = 12 (1 taxon), n = 14 (3 taxa), n = 21 (2 taxa), n = 22 (1 taxon), n = 24 (1 taxon), n = 26 (5 taxa), n = 27 (3 taxa), n = 28 (9 taxa), and n = 56 (2 taxa) [1]. Of the reported chromosome numbers, n = 28 is of most frequent occurrence. From these data, x = 7 seems to be the basic number of the genus. Polyploidy and aneuploidy seem to have played an important role in the evolution and speciation of the genus.

Entosthodon wallichii Mitt., n = 42.

The plants were collected from Srinagar (on way to Chasma-e-Shahi, alt. 1800 m, on wet soil, *PAN 4025*).

This species is known to exist in 3 cytological forms, i.e. n = 14 [4], n = 28 [7] and n = 26 [8]. In the population examined, 42 bivalents were observed at first metaphase. As in the genus *Funaria*, the bivalents showed stickiness.

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