On Chromosomes in Some Mosses, XIV. Chromosomes in Seven Species of *Andreaea*, *Tetraplodon*, *Cyptodontopsis*, *Pilotrichopsis*, *Eumiurium*, *Homalia* and *Distichophyllum*

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In the genera *Andreaea*, *Tetraplodon*, *Cyptodontopsis*, *Pilotrichopsis*, *Eumiurium*, *Homalia* and *Distichophyllum*, there is no species on which the study of gametophytic chromosomes was attempted. This report deals with the observational results of gametophytic chromosomes in one species of each of these genera.

Most of the materials studied here were given by Mr. T. Seki and Mrs. U. Mizushima, to whom the author wishes to express his sincerest thanks.

Material and Method

The species names and the localities of the materials studied are listed in Table 1.

The methods used are the same with those described in the previous papers (Yano 1957a, 1961).

Table 1. Species names and localities of the materials examined

Species name	Locality	Figure
Andreaeaceae <i>Andreaea nivalis</i> Hook.	Mt. Chokai: Yamagata Pref.	a, b, c
Splachnaceae <i>Tetraplodon mnioides</i> (Hedw.) B. S. G.	Mt. Zawo: Yamagata Pref. Mt. Shirouma: Niigata Pref.	d, e, f
Cryphaceaceae <i>Cyptodontopsis obtusifolia</i> (Nog.) Nog. <i>Pilotrichopsis dentata</i> (Mitt.) Besch.	Tsudai-mura: Kochi Pref. Mt. Mikura: Hiroshima Pref.	g, h, i j, k, l
Myuriaceae <i>Eumiurium sinicum</i> (Mitt.) Nog.	Mt. Mikura: Hiroshima Pref.	m, n
Neckeraceae <i>Homalia japonica</i> Besch.	Mt. Myoko: Niigata Pref.	o, p, q
Hookeriaceae <i>Distichophyllum maebarae</i> Besch.	Mt. Mikura: Hiroshima Pref.	r, s, t

Observations

Andreaea nivalis Hook.

The cytological study of Andreales mosses is an interesting theme, because this

order has been considered taxonomically to be peculiar and markedly remote from the other orders of mosses. Recently, Anderson and Bryan (1958) counted 10 bivalents in *Andreaea rothii* Web. et Mohr. by observing meiotic chromosomes. But no report has been made concerning gametophytic chromosomes in this genus until now. The present author could determine the karyotype by observing gametophytic chromosomes in one species of the genus, *A. nivalis*, collected on Mt. Chokai by Mrs. U. Mizushima.

This species is dioecious, and the observation of chromosomes was carried out in male gametophytes. This moss scarcely grows under artificial laboratory conditions, and accordingly the growing buds of gametophytes for fixation could not be obtained sufficiently. Though, the author succeeded in a detailed observation of chromosomes by four well-defined nuclear plates.

In each nuclear plate, there are seen obviously 10 chromosomes consisting of 6

Fig. 1. Metaphase chromosomes and heteropycnosis in gametophytes. a, b, c. *Andreaea nivalis*. d, e, f. *Tetraplodon mnioides*. g, h, i. *Cyptodontopsis obtusifolia*. j, k, l. *Pilotrichopsis dentata*. m, n. *Eumitrium sinicum*. o, p, q. *Homalia japonica*. r, s, t. *Distichophyllum maebarae*.

V-shaped ones with median centromeres and 4 J-shaped ones with subterminal centromeres. The size differences among these chromosomes are generally less than in the case of the other mosses studied. One of the V-shaped ones is larger than the others, and this is the heterochromosome H. And also, two comparatively small ones of J-shaped elements are the heterochromosomes h's.

Karyotype: $K(n)=10=V(H)+5V+2J+2J(h)$.

The specific feature of this chromosome complement is that there are seen three heterochromatic elements, and that the size differences among component elements, are comparatively small. Thus, the genus *Andreaea* shows a peculiar characteristic in karyological features too.

Tetraplodon mnioides (Hedw.) B.S.G.

This species is a nitrophilous moss growing on the faeces or carcasses of animals in the alpine belt. Monoecious. The observation of chromosomes was made in two populations collected from near the top of Kumanodake of Mt. Zawo and near the top of Sho-rengedake of Mt. Shirouma.

No cytological difference was seen between these two populations. In gametophytes, 8 chromosomes, namely, 5 V-shaped and 3 J-shaped ones were clearly observed. The two largest elements of the 5 V's and the one smallest element of the 3 J's are the heterochromosomes H's and h respectively, which show distinct heteropycnosis. In prophase or resting nuclei, many small chromatic masses were observed in addition to the three large heteropycnotic masses derived from these two H's and one h. This may be due to the fact that there are many heterochromatic regions in the other elements than the H's and h.

Karyotype: $K(n)=8=2V(H)+3V+2J+J(h)$.

Concerning the chromosome number of this species, Steere (1954) has reported $n=19$, studying Alaskan material, differing from the present count ($n=8$) in Japanese material. Although it is impossible to compare karyotypically his finding with the present result, since his study of the Alaskan material was carried out only with meiotic chromosomes; the Alaskan material may be polyploid. But it is still doubtful whether the both materials are taken from the same species. Thus, a taxonomically comparative study on Alaskan and Japanese *Tetraplodon* mosses may be an interesting problem.

The chromosome number $n=8$ has been reported in *Splachnum ovatum* by Schweizer (1923) and in *S. amplaceum* by Bornhagen (1930) (cited from Jones 1957), and $n=9$ in *S. vasculosum* by Steere (1954) and in *S. ovatum* by Anderson and Crum (1958). Accordingly, the basic number of the family Splachnaceae may be $n=8$ or $n=9$.

Cyptodontopsis obtusifolia (Nog.) Nog.

This is the first species in Chryphaceaceae on which chromosome study was made. The sex condition of this species is indistinct.

11 chromosomes were observed without exception in gametophytes. Though these

chromosomes are small in general, their morphology could be precisely analyzed in many well-defined nuclear plates. The largest V-shaped and the smallest J-shaped elements of the chromosome complement are the H and h, respectively. The other 9 elements are euchromatic which are composed of 6 V-shaped and 3 J-shaped ones.

Karyotype: $K(n)=11=V(H)+6V+3J+J(h)$.

Pilotrichopsis dentata (Mitt.) Besch.

The material studied was sterile. In gametophytes, 8 chromosomes, 4 V-shaped and 4 J-shaped, were distinctly observed. Among them the largest V and the smallest J are the H and h, respectively.

Karyotype: $K(n)=8=V(H)+3V+3J+J(h)$.

Eumuriurium sinicum (Mitt.) Nog.

In Miuriaceae, there is no species on which the chromosome study was carried out prior to the present investigation. This species is phyllodioecious, and the materials studied are all female gametophytes.

10 chromosomes were clearly observed. The largest V-shaped and the smallest J-shaped elements of the complement are the H and h, respectively. The other elements are euchromatic consisting of 2 comparatively large V's, 4 small V's and 2 small J's.

Karyotype: $K(n)=10=V(H)+6V+2J+J(h)$.

Homalia japonica Besch.

The gametophytes studied were sterile. Eleven chromosomes are seen distinctly. Of these, the largest V-shaped and the smallest J-shaped elements are the heterochromosome H and h, respectively. In prophase or resting nuclei, the heteropycnosis of these H and h is clearly observed. The other elements are euchromatic which are composed of 3 comparatively large ones (V, 2J) and 6 comparatively small ones (4V, 2J).

Karyotype: $K(n)=11=V(H)+5V+4J+J(h)$.

This chromosome complement is morphologically similar to that of the genus *Thamnium* reported before (Yano 1952, 1957c).

Distichophyllum maebarae Besch.

The chromosome study of Hookeriaceae mosses was carried out only with one species, *Hookeria nipponensis* (Besch.) Broth., by Tatuno (1951) who reported its chromosome number as $n=11$. The present author studied chromosomes in another species, *Distichophyllum maebarae*, of the same family.

The gametophytes studied here were sterile. The chromosome complement ($n=10$) is composed of 7 V-shaped elements with median centromeres and 3 J-shaped elements with subterminal centromeres. The 2 largest elements of the 7 V's are the heterochromosome H's which show heteropycnosis. The other V's *i.e.* 2 comparatively large ones and 3 small ones, are euchromatic. The 3 J-shaped elements are all

small. One of these J's is a minute heterochromosome (h). In prophase or resting nuclei, 3 heteropycnotic masses derived from these two H's and one h are seen.

Karyotype: $K(n)=10=2V(H)+5V+2J+J(h)$.

Summary

The gametophytic chromosomes of 7 moss species belonging to 6 families were studied. Their chromosome complements are formulated as follows:

Andreaeaceae

Andreaea nivalis Hook. $K(n)=10=V(H)+5V+2J+2J(h)$

Splachnaceae

Tetraplodon mnioides (Hedw.) B.S.G. $K(n)=8=2V(H)+3V+2J+J(h)$

Cryphaceaceae

Cyptodontopsits obutusifolia (Nog.) Nog. $K(n)=11=V(H)+6V+3J+J(h)$

Pilotrichopsis dentata (Mitt.) Besch. $K(n)=8=V(H)+3V+3J+J(h)$

Myuriaceae

Eumuriurium sinicum (Mitt.) Nog. $K(n)=10=V(H)+6V+2J+J(h)$

Neckeraceae

Homalia japonica Besch. $K(n)=11=V(H)+5V+4J+J(h)$

Hookeriaceae

Distichophyllum maebarae Besch. $K(n)=10=2V(H)+5V+2J+J(h)$

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