Jap. J. Phycol. (Sôrui) 33: 288-292. December 10, 1985

Meiosis in three species of *Laurencia* (Ceramiales, Rhodophyta)

Hiroshi YABU

Faculty of Fisheries, Hokkaido University, Hakodate, Hokkaido, 041 Japan

YABU, H. 1985. Meiosis in three species of *Laurencia* (Ceramiales, Rhodophyta). Jap. J. Phycol. 33: 288-292.

Meiotic divisions in the tetrasporanga of three species of *Laurencia* (*L. undulata* Yamada, *L. okamurai* Yamada and *L. pinnata* Yamada) revealed noticeable differences at meiosis I between *L. undulata* and the other two species as follows: In *L. undulata*, chromatin threads at early prophase were thicker, chromosomes at late prophase were usually squarish, a faintly stained large polar cap was visible and the chromosome complement was n=30 with one large chromosome, whereas in *L. okamurai* and *L. pinnata*, chromatin threads at early prophase were thinner, chromosomes at late prophase were spherical or dumbbell-shaped, the polar cap was absent and the chromosome complement was n=32 with three and one small chromosomes respectively.

Key Index Word: *Ceramiales*; *chromosome*; Laurencia; L. okamurai; L. pinnata; L. undulata; *meiosis*.

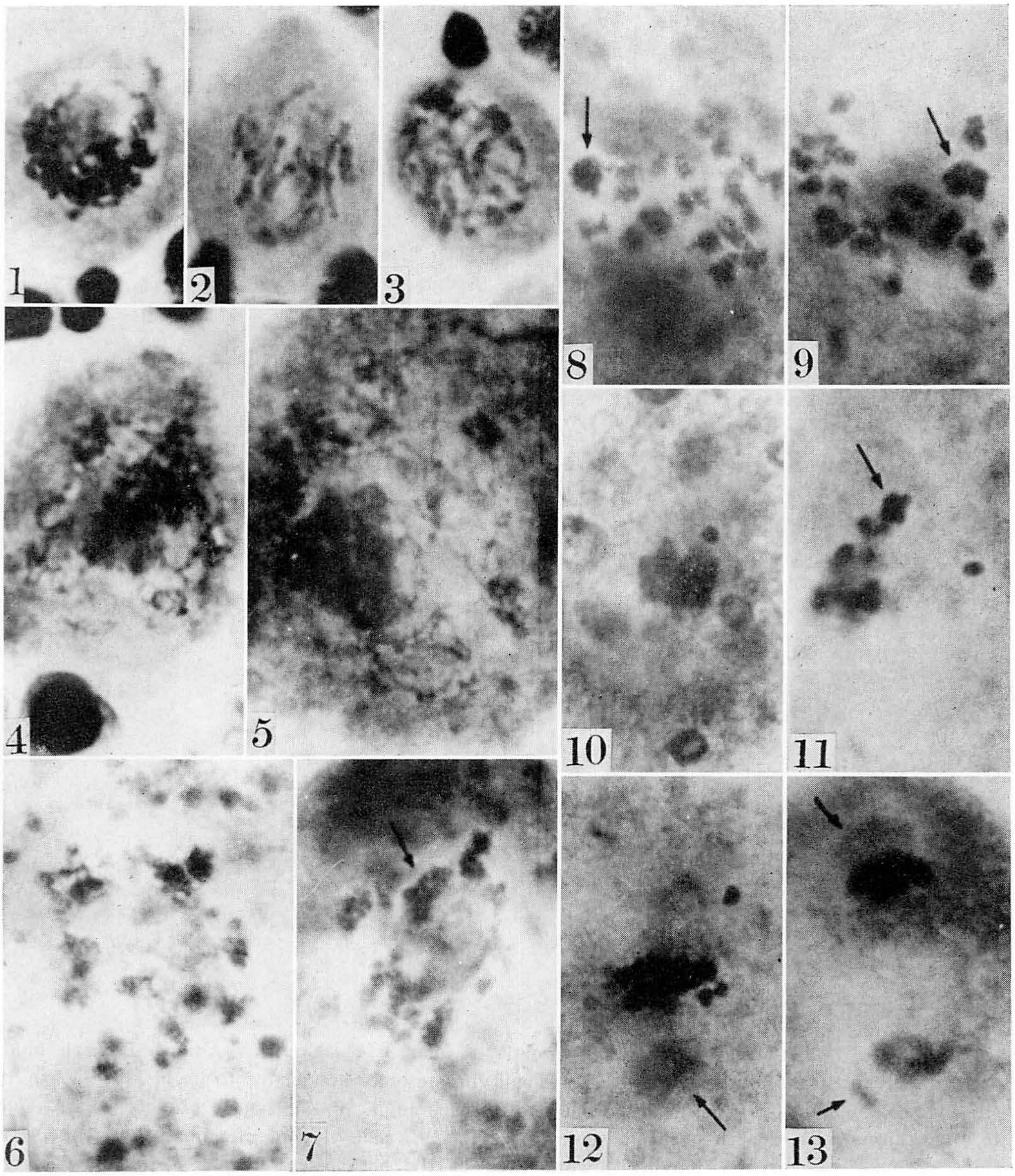
The Genus *Laurencia* is comprised of more than sixty species, most of which are distributed in temperate regions (YAMADA, 1931). To date, cytological treatises on this genus are restricted to five species; *L. hybrida* (WESTBROOK, 19S5), *L. nipponica* (YABU, 1978), *L. obtusa* var, *majuscula* (YABU & KAWAMURA, 1959), *L. papillosa* (YABU & KAWAMURA, 1959; CORDEIRO-MARINO, YAMAGUISHI-TOMITA & YABU, 1974) and *L. pinnatifida* (KYLIN, 1923; GRUBB, 1925; WESTBROOK, 1928; 1935; AUSTIN, 1956; MAGNE, 1964). In this paper, the results of observations of meiosis for three species of *Laurencia* from Japan, *L. undulata*, *L. okamurai* and *L. pinnata*, are presented.

Materials and Methods

The materials used for this study are *Laurencia undulata* collected from Okinoshima in Shimane Prefecture in July 1974 and from Makurazaki in Kagoshima Prefecture in May 1978; *L. okamurai* from Moheji near Hakodate, Hokkaido in August 1972-1975; and *L. pinnata* from Tachimachi-Misaki in Hakodate, Hokkaido from May through July, 1970-1973. The plants were kept alive in vats with seawater until the time of fixing. Maturing portions of tetrasporophytes were fixed in ethanol acetic acid (3:1) and stained with aceto-iron-haematoxylin-chloral hydrate solution (WITTMANN, 1965).

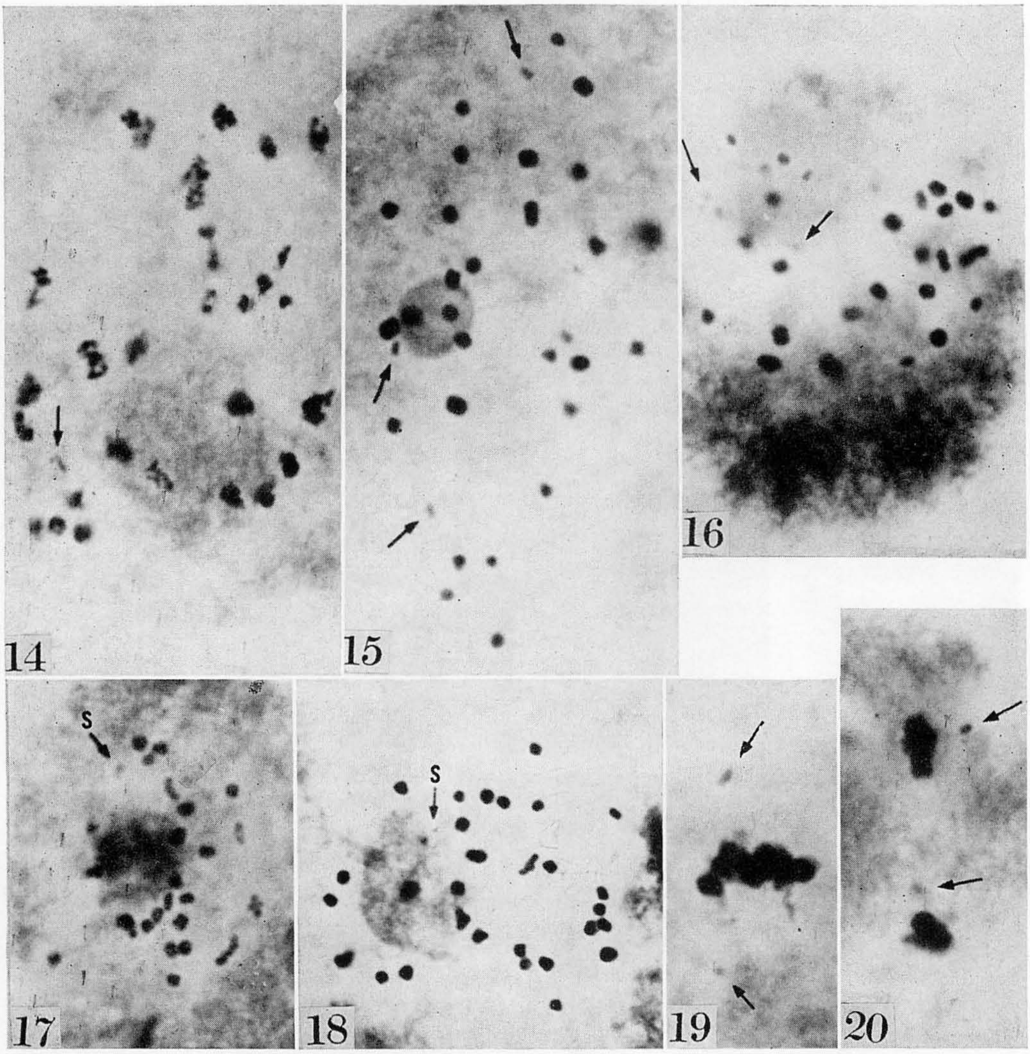
Results

The meiotic features in the tetrasporangia of the three *Laurencia* species treated here were identical to that of *L. nipponica* (YABU, 1978). The early prophase nucleus in young tetrasporangia of all the materials has prominent chromatin threads around a faintly stained fairly large nucleus. These threads then gather at a corner of the nuclear cavity and gradually change into coiled strands which afterwards become loose and elongate, expanding within the nuclear cavity (Figs. 1-5). Passing through an obvious diffuse stage, chromosomes emerge (Figs. 6-7) and soon transform into distinct individuals. The chromatin threads at early prophase are thicker in *L. undulata* than in the other two



Figs 1–13. Various nuclear stages in the tetrasporangia of *Laurencia undulata*. Figs 1–5. Successive stages from synapsis to diplotene. Fig. 6. Early diakinesis. Fig. 7. More advanced stage with the large chromosome (arrow) which already exhibits its outline. Figs. 8 & 9. Diakinesis with the large chromosome (arrow). Figs 10–12. Diakinesis with a precocious chromosome moving toward one of the poles. The large chromosome (in Fig. 11) and the polar cap (in Fig. 12) are indicated by arrows. Fig. 13. Anaphase with a polar cap (arrow). All figures. ×1,280.

species. On the whole, the chromosomes from late diakinesis to metaphase I were larger and angular in *L. undulata*, but in the others were smaller and dumbell or spherical in shape. The chromosome count from diakinesis to early metaphase I was estimated to be n=30 for *L. undulata* and n=32 for the others. The chromosome complement



Figs 14-16. Diakinesis in the tetrasporangia of *Laurencia okamurai*. Arrows in each figure indicate the small chromosome. The other small chromosomes are out of focus in Figs 14 and 16.

Figs 17-20. Various nuclear stages in the tetrasporangia of *Laurencia pinnata*. Figs. 17 & 18. Diakinesis with the small chromosome (s). Fig. 19. Side view of metaphase I with a precocious chromosome (arrow) moving toward each of the both poles. Fig. 20. Side view of the daughter nuclei at metaphase II with a precocious chromosome (arrow) moving toward one of the poles in each nucleus. All figures. ×1,280.

Table 1. Normal and anomalous nuclei in 100 side views at meiosis I.

Species	Number of normal nuclei	Number of anomalous nuclei
Laurencia undulata	77	type A=23; type B=0
L. okamurai	82	type A=13; type B=5
L. pinnata	84	type A=10; type B=6

Type A=anomalous nucleus with a precocious chromosome moving toward one of the poles; Type B=anomalous nucleus with a precocious chromosome moving toward each of the both poles.

Table 2. Chromosome numbers previously recorded in species of *Laurencia*.

Species	Chromosome number	Investigator
L. hybrida	n=ca 20; 2n=ca 40	Westbrook, 1935
L. nipponica	n=28	Yabu, 1978
L. obtusa var. *majuscula*	n=20; 2n=40	Yabu & Kawamura 1959
L. papillosa	n=20; 2n=40	Yabu & Kawamura 1959
	n=26	Cordeiro-Marino *et al*., 1974
L. pinnatifida	n=ca 20	Kylin, 1923
	n=15-16	Grubb, 1925
	n=ca 20; 2n=ca 40	Westbrook, 1928; 1935
	n=29; 2n=58	Austin, 1956
	n=29	Magne, 1964
L. undulata	n=30	Present study
L. okamurai	n=32	〃
L. pinnata	n=32	〃

contains one large chromosome in *L. undulata* (Figs. 7-9, 11), three small chromosomes in *L. okamurai* (Figs. 14-16) and one small chromosome in *L. pinnata* (Figs. 17-18). A weakly stained, large polar cap was visible in *L. undulata* (Figs. 12-13), but it was absent in the others. In all of the three species treated here, the anomalous nuclei with a precocious chromosome frequently appeared at metaphase I & II (Figs. 10-11, 19-20). There are two types of anomalous nuclei at metaphase I; type A with a precocious chromosome moving toward one pole, and type B with a precocious chromosome moving toward each of the both poles. The counts for normal and anomalous nuclei at metaphase I in each species are given in Table 1. These results demonstrate that only the type A appeared in *L. undulata*, however, type A and B both appeared in *L. okamurai* and *L. pinnata*. In *L. undulata*, anomalous nuclei at meiosis II had a precocious chromosome moving toward a pole in one or both of the daughter nuclei but in *L. okamurai* and *L. pinnata*, such a nucleus had a precocious chromosome moving toward each of the both poles in one or both of the daughter nuclei.

Discussion

In the present study on *Laurencia undulata*, *L. okamurai* and *L. pinnata*, tetrasporangia in meiosis I revealed noticeable differences between *L. undulata* and the other two species in the thickness of chromatin threads at early prophase, the chromosome complement and the existence of a polar cap.

SAITO (1967), who studied the Japanese species of *Laurencia*, separated the genus into two subgenera *Laurencia* and *Chondrophyca* based upon differences in the formation of tetrasporangia and the secondary pit-connection, and placed *L. okamurai* and *L. pinnata* in the former subgenus and *L. undulata* in the latter. Whether the above cytological differences relate to these two subgenera or not must be an interesting taxonomic problem, but further studies on other species of *Laurencia* are needed.

As seen in Table 2, the chromosome numbers of n=30 for *L. undulata* and n=32 for *L. okamurai* and *L. pinnata* are not in accord with the previous number recorded for several species of *Laurencia*. This is also worthy of attention for further cytological research on the genus *Laurencia*.

Acknowledgements

I am grateful to Dr. J. MCLACHLAN of National Research Council Canada for his valuable comments. I would also like to thank Mr. M. KAJIMURA of Shimane University and Mr. T. NORO of Kagoshima University for their kind support in collection of the materials.

References

AUSTIN, A.P. 1956. Chromosome counts in the Rhodophyceae. Nature (Lond.) **175**: 950.

CORDEIRO-MARINO, M., YAMAGUISHI-TOMITA, N. and YABU, H. 1974. Nuclear divisions in the tetrasporangium of *Acanthophora specifera* (Vahl) Boergesen and *Laurncia papillosa* (Forsk.) Greville. Bull. Fac. Fish. Hokkaido Univ. **25**: 79-81.

GRUPP, V.M. 1925. The male organs of the Florideae. J. Linn. Soc. Bot. **47**: 177-255.

KYLIN, H. 1923. Studien über die Entwicklungsgeschichte der Florideen. K. svenska Vetensk Akad. Handl., **63**(11) : 1-139.

MAGNE, F. 1964. Recherches caryologiques ches les Floridées (Rhodophycées). Cah. Biol. mar. **5**: 461-671.

SAITO, Y. 1967. Studies on Japanese species of *Laurencia* with special reference to their comparative morphology. Mem. Fac. Fish. Hokkaido Univ. **15**: 1-81.

WESTBROOK, M.A. 1928. Contributions to the cytology of tetrasporic plants of *Rhodymenia palmata* (L.) Grev., and some other Florideae. Ann. Bot. (Lond.) **42**: 149-172.

WESTBROOK, M.A. 1935. Observations on nuclear structure in the Florideae. Beih. bot. Zbl. A **53**: 564-585.

WITTMANN, W. 1965. Aceto-iron-haematoxylin-chloral hydrate for chromosome staining. Stain Tech. **40**: 161-164.

YABU, H. 1978. Nuclear divisions in *Laurencia nipponica* Yamada. Jap. J. Phycol. **26**: 35-39.

YABU, H. and KAWAMURA, K. 1959. Cytological study of some Japanese species of Rhodomelaceae. Mem. Fac. Fish., Hokkaido Univ. **7**: 61-71.

YAMADA, 1931. Notes on *Laurencia*, with special reference to the Japanese species. Univ. Calif. Pub. Bot. **16**(7) : 185-310.

籔　凞：紅藻ソゾ属3種の減数分裂

コブソゾ，ミツデソゾ，ハネソゾの四分胞子嚢内核分裂を観察し，減数第1分裂でコブソゾと他の2種のソゾとの間には注目すべき差異が認められた。コブソゾでは核分裂前期初期の染色糸は太く，前期末期の染色体は通常角ばった形状を呈し，極には色素に薄く染まる極帽が存在し，染色体は n=30 でそのうちの1個は他のものよりも大きい。一方，ミツデソゾとハネソゾでは核分裂前期初期の染色糸は細く，前期末期の染色体は球形又は亜鈴形で極帽はなく，染色体は n=32 でそのうちミツデソゾの3個とハネソゾの1個は他のものよりも小さい。
(041 北海道函館市港町3丁目 1-1，北海道大学水産学部)