

The male gametophyte of Japanese *Palmaria palmata* (Rhodophyta)

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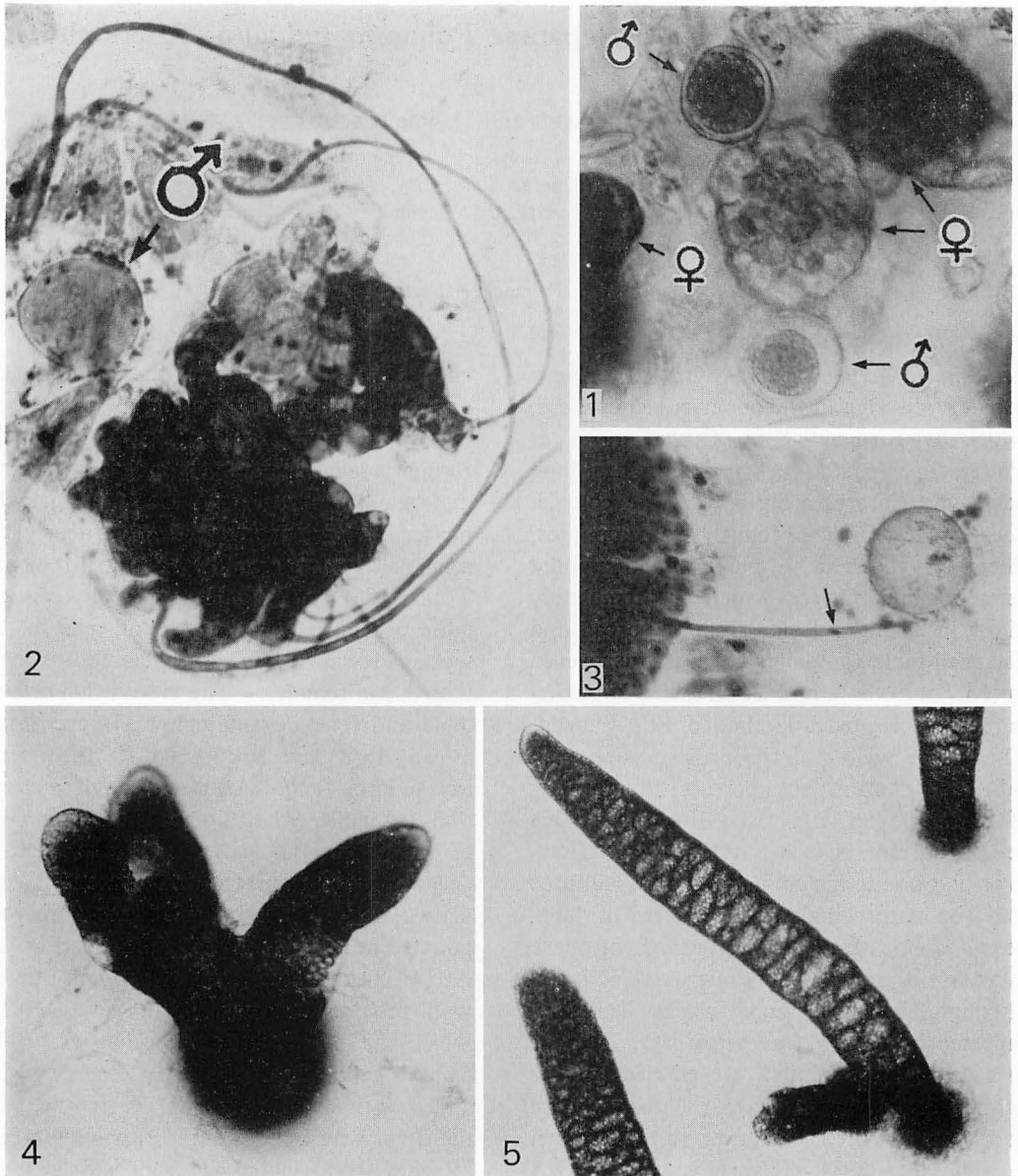
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Palmaria palmata (L.) O. KUNTZE, a very popular red alga in the northern hemisphere, which was renamed by GUIRY (1975) as *Rhodymenia palmata* (L.) Grev., has long been very interesting to many phycologist due to lack of the female gametophytes. Recently, the minute narrow and stunted female gametophytes which are completely differ in shape and size from the broad and flattened male gametophytes were discovered by VAN DER MEER and TODD (1980) in culturing tetraspores from the thalli of East Canada. The senior writer of the present paper had failed to confirm the perfect life history of *Palmaria palmata* from Hokkaido in his several culture trials during 1970-1980. However he came to his opinion from his cultures that the mature male gametophytes of Japanese *Palmaria palmata* in their usual phase must be extremely minute microscopic plants, although the macroscopic males had been reported by several investigators. In order to ascertain his opinion, we carried out the culture of tetraspores from the thalli which had been collected in March through April in 1983 and 1984 at various places, viz., Anama, Tachimachi-Misaki, Shinori and Nanaehama in Hakodate, Hokkaido, and Usujiri in its neighbourhood.

All cultures of the present work were made under 8-10°C, 12:12 photoperiod at 1,500 lux in the modified Grund medium (MCLACHLAN 1973).

In every culture of our materials, similar results were obtained, and in about two weeks culture, two forms of tetraspore germlings were usually discernible at the ratio approxi-

mately 1:1 as follows: one form is the germling with trichogyne and the other form is the germling without trichogyne; the former is female gametophyte and the latter is male one. In our cultures, the female gametophytes in their development were nearly the same as those reported by VAN DER MEER and TODD (1980), but the male gametophytes were quite peculiar. The number of cells in one week old was 1-8 in males, but 30 to more than 200 in females. The maturation of both male and female gametophytes were found already in 4 days culture and it lasts nearly two months long. At the start of maturation in males, the pigments in their cells begin to become pale as if the cell is decaying, and after the cell content is condensed, it is quickly divided into numerous minute granules to form spermatia (Fig. 1). After finishing spermatia formation, the cell wall provides a very small pore, through which the spermatia are discharged. The empty cell remained for a short while, and soon it completely vanished away. On the slides where the germlings were sparsely attached, the trichogynes from females were occasionally found elongating toward a mature male (Fig. 2). In the stain with acetocarmine or aceto-iron-haematoxylin-chloral hydrate solution, the male nucleus passing through trichogyne was found frequently (Fig. 3). When the female gametophytes attain the disk consisting of a number of cells, they occasionally begin to have upheaval from its central portion, which soon or later also protrude trichogynes (Fig. 4). In our cultures, the erect fronds without



Figs. 1-5. Tetraspore-germlings of *Palmaria palmata* (L.) O. KUNTZE 1. Male and female gametophytes in 12 days old culture. Male gametophytes attain maturity. $\times 400$. 2. Two female gametophytes with long hair-like trichogynes, each of which elongates toward a mature male. From a 14 days old culture. $\times 600$. 3. A trichogyne being connected to a male gametophyte, from which the spermatia were already discharged (Stained with aceto-iron-haematoxylin-chloral hydrate solution). Male nucleus in the trichogyne is indicated by arrow. From a culture 15 days old. $\times 300$. 4. A female gametophyte with two upheavals, from which many trichogynes are also protruded. From a culture 34 days old. $\times 150$. 5. Erect frond regarded as young tetrasporophyte on the disk-shaped female gametophyte. From a culture 34 days old. $\times 60$.

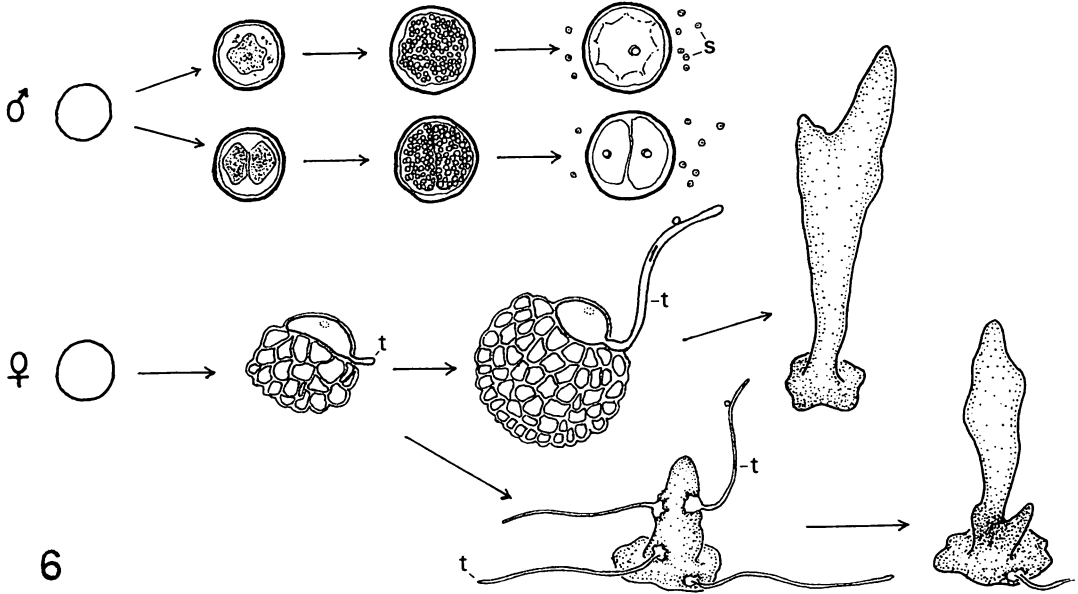


Fig. 6. Schematic illustration on the male and female gametophytes developed from the tetraspore-germlings of *Palmaria palmata* in Hakodate, Hokkaido, Japan. (s; spermatium, t; trichogyne)

trichogyne as be shown in Fig. 5, which are supposed to be young tetrasporophytes, were produced only on the disks with trichogyne (females) and none on the disks without trichogyne (males). In spite of our efforts, tetraspore formation has not been detected in any of the erect fronds in our cultures as yet.

In Japan, the reproductive organs of the macroscopic fronds of male gametophytes have been described by TAZAWA (1975) and LEE (1978) for the materials from Hokkaido. However, according to our collections of *Palmaria palmata* along the coast of the Oshima Peninsula in southern Hokkaido, the fronds of this alga were always mostly tetrasporophytes and very rarely male gametophytes. This fact and the present culture results (Fig. 6) strongly suggest that the male gametophytes of Japanese *Palmaria palmata*, at least in Hakodate and its neighbourhood, would be sure to ordinarily exist in the state of microscopic plants consisting of only one to a few cells in the sea.

The haploid chromosome number of *Palmaria palmata* has been reported as 26 (YABU 1971) and 26 or 21 (YABU 1976) in the

species from Japan, and 22-23 (VAN DER MEER 1976) and 21 (VAN DER MEER and CHEN 1979) in the species from Canada. The occurrence of the minute male gametophytes of *Palmaria palmata* found by us seems to indicate the possibility of this alga as being quite different species between in the both countries. The detailed observations on the female gametophytes in our study will be described elsewhere after ascertaining the complete life cycle in culture.

References

- GUIRY, M. D. 1975. An assessment of *Palmaria palmata* forma *mollis* (S. et G.) comb. nov. (= *Rhodymenia palmata* forma *mollis* S. et G.) in the eastern North Pacific. *Syesis* 8: 245-261.
- LEE, K. 1978. Studies on Rhodymeniales from Hokkaido. *Fac. Sci. Hokkaido Univ. Journ.* 5 (Botany) 11: 1-194.
- MCLACHLAN, J. 1973. Growth media-marine. In E. R. STEIN [ed.] *Handbook of Phycological Methods*. pp. 25-57. Cambridge University Press, New York.
- TAZAWA, N. 1975. A study of the male reproductive organs of the Florideae from Japan. *Sci. Pap. Inst. Alg. Res. Hokkaido Univ.* 6:

- 95-179.
- VAN DER MEER, J.P. 1976. A contribution towards elucidating the life history of *Palmaria palmata* (= *Rhodymenia palmata*). Can. J. Bot. 54: 2903-2906.
- VAN DER MEER, J.P. and CHEN, L.C.-M. 1979. Evidence for sexual reproduction in the red algae *Palmaria palmata* and *Halosaccion ramentaceum*. Can. J. Bot. 57: 2452-2459.
- VAN DER MEER, J.P. and TODD, E.R. 1980. The life history of *Palmaria palmata* in culture. A new type for the Rhodophyta. Can. J. Bot. 58: 1250-1256.
- YABU, H. 1971. Nuclear division in tetrasporophytes of *Rhodymenia palmata* (L.) GREV. Proc. Int. Seaweed Symp. 7: 205-207.
- YABU, H. 1976. A report on the cytology of *Rhodymenia palmata*, *Rh. pertusa* and *Halosaccion saccatum* (Rhodopyta). Bull. Fac. Fish. Hokkaido Univ. 27: 51-62.

藪 潔・安井 肇：日本産ダリスの雄性配偶体

函館とその近傍で採集したダリスの四分胞子を培養し、成熟した雄性体と雌性体とを得た。雌性体は既にカナダ産のダリスの培養で見出されているものと同形の体となった。しかし、雄性体は今迄報告されている四分胞子体と同形の体とは全く異なり、微小な1~8個細胞よりなる体で成熟した。雄性体の成熟は培養開始後4日から約2ヶ月の間にわたって認められた。その成熟は体を構成する全ての細胞で始まり、各細胞内には多数の精子が形成され放出された。筆者らの北海道渡島半島沿岸での採集調査では、ダリスの雄性体は極めて少ない。本培養の結果からみると、自然界における日本産ダリスの雄性配偶体は通常この微小な状態で生育しているものと考えられる。(041 函館市港町3丁目1番1号 北海道大学水産学部)