

**On spore germination in *Binghamiella californica* (FARLOW)
SETCHELL et DAWSON (Rhodophyta, Champiaceae)**

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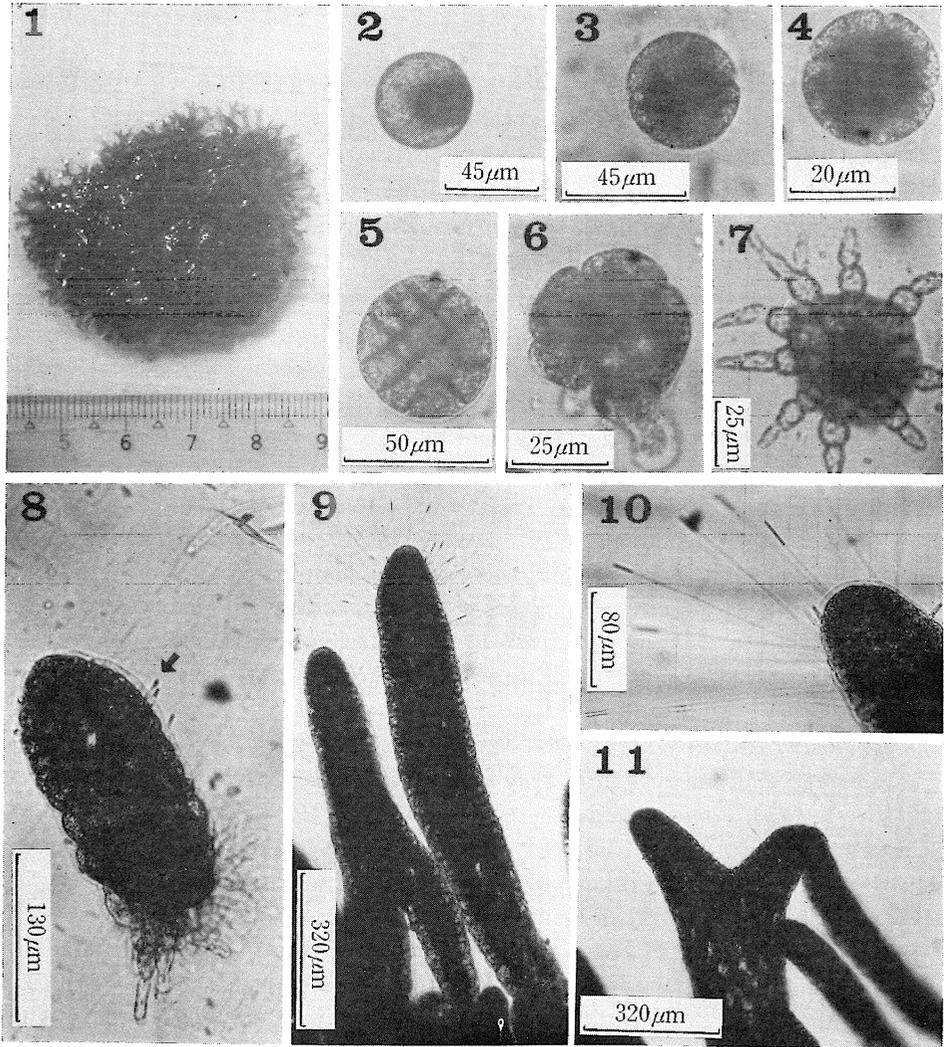
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The carpospore- and tetraspore-germlings of *Binghamiella californica* (FARLOW) SETCHELL et DAWSON which is a new record for the Japan Sea coast of Honshū were observed to develop taking a form of the immediate discal type. In this paper are also described some facts from which it may be said that there exists a correlation between the divisional type of tetrasporangia and the developmental type of spore-germlings among the species of Rhodymeniales. That is to say, the spore-germlings of the species with cruciately divided tetrasporangia develop taking a form of the tetraproto-cellular type, whereas those of the species with tetrahedrally divided tetrasporangia develop taking a form of the immediate discal type. The spore-germlings of the present species, when observed 30 days after spore discharge, were found to bear numerous hairs.

Binghamiella californica (FARLOW) SETCHELL et DAWSON (Fig. 1), which belongs to Champiaceae in Rhodymeniales, Rhodophyta, has been reported to date (AGARDH 1894, INAGAKI 1933, TOKIDA and MASAKI 1959, SEGAWA 1936, KANG 1966, KAWASHIMA 1957, LEE and KUROGI 1973) from the Pacific coast of the United States, the Japan Sea coast of Hokkaido and the Pacific coast of northern to middle Honshū in Japan, and the southern coast of the Korean Peninsula.

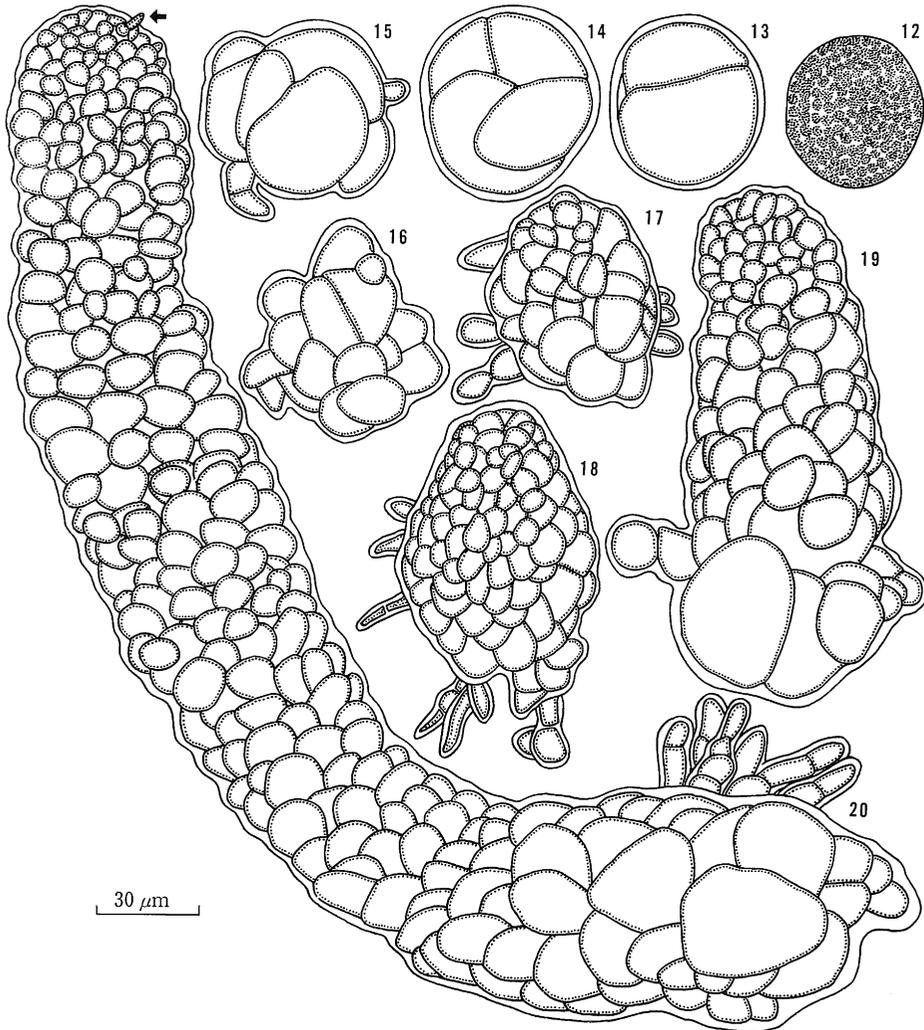
In April 1977, the writer could collect mature female gametophytes of this species in deep-sea off the Oki Islands, Shimane Prefecture (36°9'6" N. L., 133°14'42" E. L.), and the mature tetrasporophytes from the same locality in March, 1979. This is the new record of the alga in the Japan Sea coast of Honshū. In the present paper is reported a result of the writer's observations on the germination of carpospore and tetraspore in this species which has been left untouched by anyone else to this day.

The specimens studied were found epiphytic on *Lithothamnium* sp. and epizoic on sponge collected by the writer at the depth of 20 m and 40 m off Tsudo, Dōgo, Oki Isls., on April 1st, 1977 and on March 9th, 1979. They are ca. 4 cm high. The branches, ca. 1 mm broad, are attached to each other by rhizoids issued from their ventral surfaces, and as a result the branches are overlapping one another several times.



Figs. 1-11. *Binghamiella californica*.

1, A fresh mature female gametophyte collected from deep sea off Tsudo, the Oki Isls., Shimane Prefecture on April 1st, 1977; 2, A carpospore five hours after discharge; 3, A two-celled carpospore-germ, one day after discharge; 4, A four-celled carpospore-germ, two days after discharge; 5, A many-celled carpospore-germ, three days after discharge; 6, A carpospore-germ, four days old, with two filamentous growths; 7, A carpospore-germ, seven days old, with many filamentous growths; 8, An erect carpospore-germ, 15 days old, with some initials of hair on its surface pointed by arrow; 9, Erect simple carpospore-germs, 29 days old with many hairs on the apical portions of them; 10, The hairs on the apical portion of the 29 days old erect carpospore-germ; 11, The upper part of 32 days old, erect, forking carpospore-germ.



Figs. 12–20. *Binghamiella californica*.

12, A tetraspore just after discharge; 13, A two-celled tetraspore-germling, one day after discharge; 14, A four-celled tetraspore-germling, two days after discharge; 15, A tetraspore-germling, four days old, with two filamentous growths; 16, A many-celled tetraspore-germling, six days old, with two filamentous growths; 17, A tetraspore-germling, eight days old, with many filamentous growths; 18, An erect tetraspore-germling, 15 days old; 19, An erect tetraspore-germling, 20 days old; 20, An erect simple tetraspore-germling, 29 days old, with an initial of hair on its surface pointed by arrow.

The discharged spores were cultured in filtered and sterilized seawater under 13°C and constant 800 lux, being illuminated by a cool-white-fluorescent lamp.

The specimens were found to bear on frond surface numerous unicellular colorless hairs, ca. 50 μm long and 3 μm diam., arising from the outermost cortical cells.

The spores just after discharge were irregular in shape with uneven surfaces, but they gradually became spherical. The discharged carospores were 10–60 μm in diam. and the tetraspores were 30–80 μm in diam. respectively (Figs. 2, 12). This species seems to be incomparable with any other known members of Rhodymeniales, in having such a wide size range of spores, which covers the spore size of the following eight species: *Chrysomenia wrightii* (25 μm) (INOH 1941), *Coelarthrum muelleri* (28 μm) (INOH 1943) and *Rhodymenia palmata* (31 μm) (INOH 1947) in Rhodymeniaceae, and *Lomentaria rosea* (28 μm , carospore) (INOH 1947), *L. uncinata* (45 μm , carospore) (DERICK 1899), *L. catenata* (56 μm) (INOH 1947), *L. lubrica* (39 μm , tetraspore) (INOH 1947) and *Chylocladia clavellosa* (60–80 μm , tetraspore) (KILLIAN 1914) in Champiaceae.

The spore-germlings of the species under consideration were observed to develop taking a form of the immediate discal type (Figs. 3–7, 13–17). So the species belongs to the same category of spore germination as other species so far studied in Champiaceae, namely, *Lomentaria catenata* (INOH 1947), *L. clavellosa* (INOH 1947), *L. lubrica* (INOH 1947), *L. rosea* (INOH 1947), *L. uncinata* (DERICK 1899), *Champia parvula* (DERICK 1899, DAVIS 1892), *Chylocladia clavellosa* (KILLIAN 1914), *Chy. kaliformis* (INOH 1947), and *Chy. ovatum* (CHEMIN 1937). On the other hand, the species belonging to Rhodymeniaceae, such as *Chrysomenia grandis* (KAJIMURA 1977), *Chr. microphysa* (KILLIAN 1914), and *Chr. wrightii* (INOH 1941), but not *Rhodymenia palmata* (INOH 1939), are known to be tetraprotocellular type in their spore germination. From this fact it may be said that there exists a correlation between the divisional type of tetrasporangia and the developmental type of spore-germlings among the species of Rhodymeniales. That is to say, the spore-germlings of the species with cruciately divided tetrasporangia develop taking a form of the tetraprotocellular type, whereas those of the species with tetrahedrally divided tetrasporangia develop taking a form of the immediate discal type.

The spore-germlings of the present species, when observed 30 days after spore discharge, were found to bear numerous hairs resembling those on the frond surface of mature plants, but much longer than them attaining to 160 μm or more in length (Figs. 9–11).

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