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Vegetative propagation and spore germination in *Distromium decumbens* (OKAMURA) LEVRING (Phaeophyta, Dictyotaceae) in culture[1]

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Results of the present writer's observations on vegetative propagation and spore germination of *Distromium decumbens* (OKAMURA) LEVRING (Phaeophyta, Dictyotaceae) in culture are reported herein.

Vegetative propagation occurs from frond margin and rhizoids but the latter case is more common. Secondary frond produces the secondary rhizoids which also produce tertiary fronds producing tertiary rhizoids. Spores of this alga germinate according to the same pattern as the one known in *Dictyopteris prolifera* (OKAMURA) OKAMURA, *D. undulata* HOLMES, *Spathoglossum pacificum* YENDO, *Stypopodium zonale* (LAMOUROUX) PAPENFUSS and *Zonaria diesingiana* J. AGARDH.

Key Index Words: *vegetative propagation, spore germination,* Distromium decumbens, *Phaeophyta, Dictyotaceae.*

Introduction

Vegetative propagation and spore germination have not been reported for *Distromium decumbens* (OKAMURA) LEVRING (1940) to date since its basionym *Chlanidote repens* OKAMURA (1907) was newly reported. The present writer could very frequently collect many mature specimens of this alga from deep-water in the vicinity of the Oki Islands, Shimane Prefecture in the course of his study on deep-water flora which started in 1966 and also could study on the vegetative propagation and spore germination of this alga in culture.

Materials and Methods

Mature specimens of this alga used for this study were collected by the present writer at a depth of 30 m off Tsudo, the Oki Islands, Shimane Prefecture on August 4, 1978. Culture of mature fronds and discharged spores were carried out according to standard techniques (CHAPMAN 1975) and at 19°C (corresponding to the mean water temperature at 50 m in the vicinity of the Oki Islands in summer according to the

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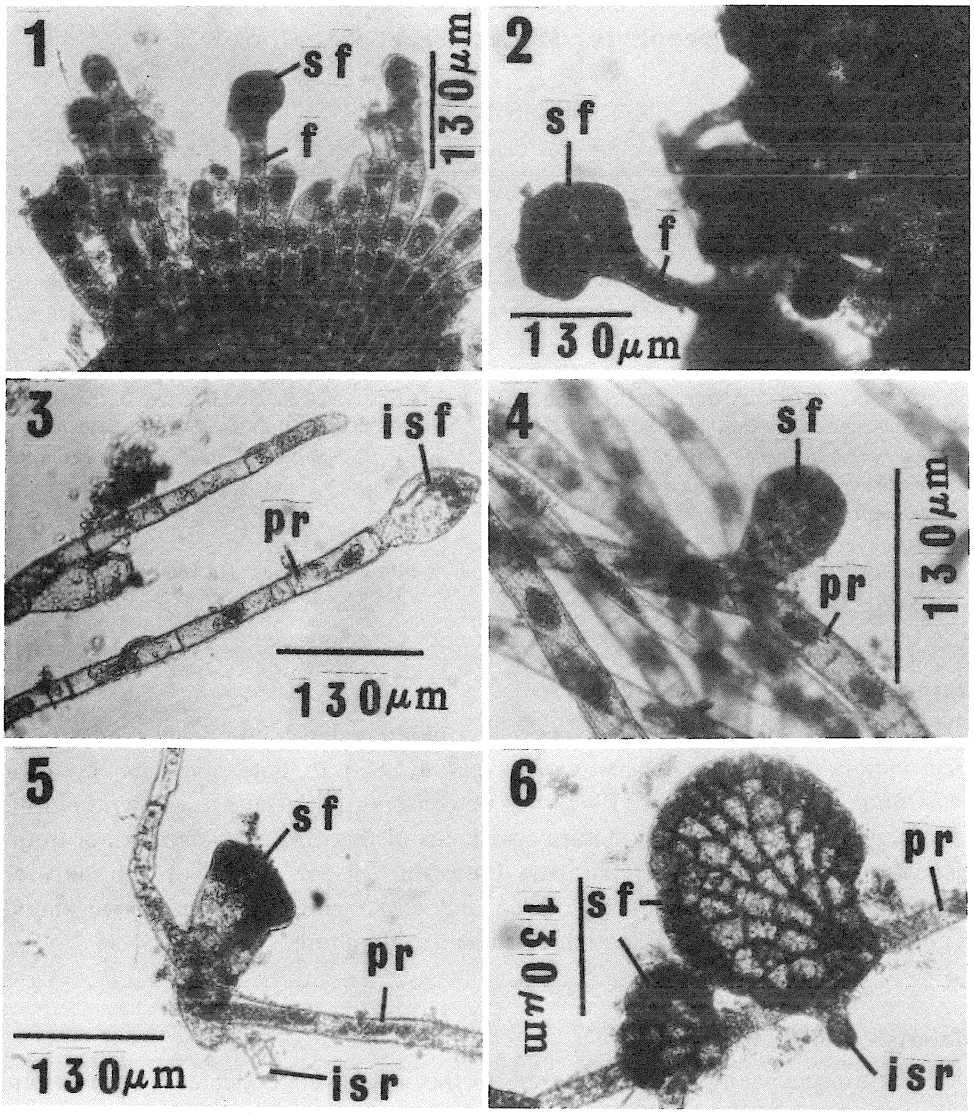
Japan Oceanographic Data Center 1973) and 2400 lux continuous illumination. The culture medium (Erdschreiber) was used.



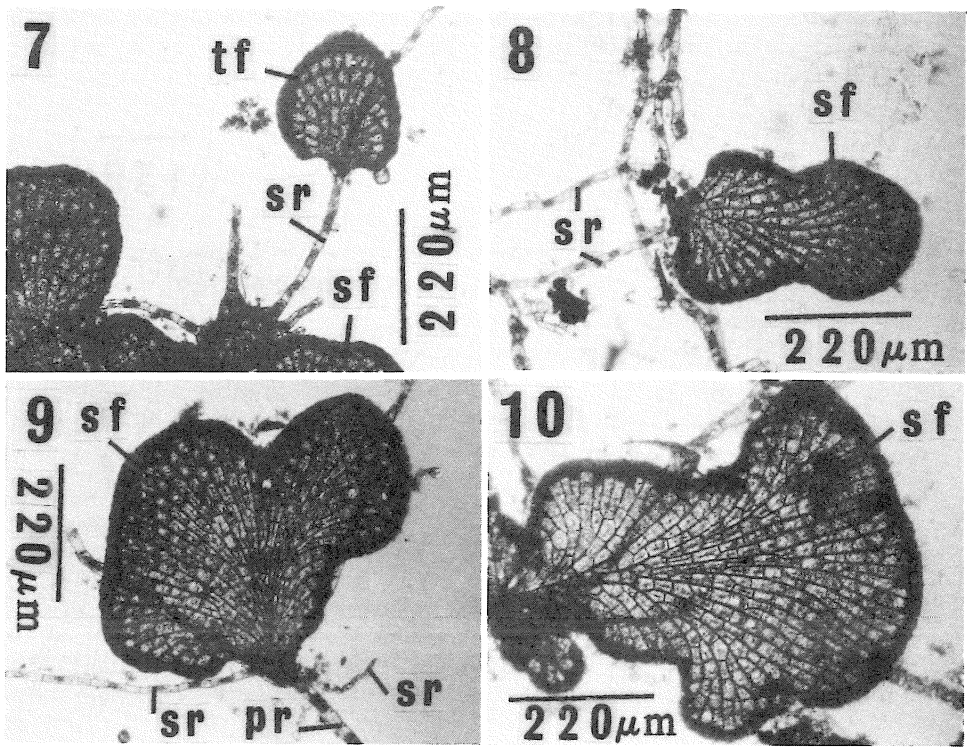
Figs 1–6. *Distromium decumbens* (OKAMURA) LEVRING.
Figs 1–2. Vegetative propagation from frond margin.
Fig. 3. Initial cell of a secondary frond arising from the tip of the primary rhizoid.
Figs 4–5. Secondary fronds at initial stage of development, arising laterally from the primary rhizoid.
Fig. 6. Two secondary fronds developing laterally from the primary rhizoid.

Observations and Discussion

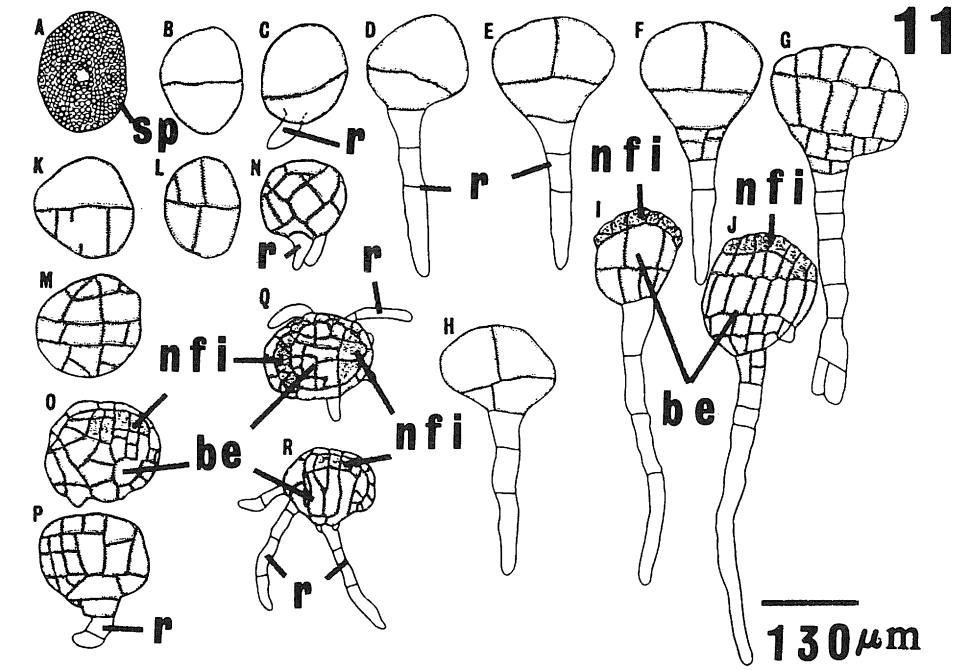
Vegetative propagation

Vegetative propagation occurs on the frond margin and rhizoid. In the former case, marginal cells of frond divide repeatedly and transversely to form several cells long filaments prior to the initiation of the secondary frond terminally on them (Figs 1–2), and the secondary frond produces secondary rhizoids in the similar manner as the one in the latter case mentioned below.

In the latter case, development of the secondary fronds is initiated terminally (Fig. 3) or laterally (Figs 4–10) from the primary rhizoids. When the secondary fronds attain the length of several cells, development of one or more secondary rhizoids is initiated from their lower margin (Figs 5–6), or lower ventral surface.



Figs 7–10. *Distromium decumbens* (OKAMURA) LEVRING.
Fig. 7. A tertiary frond arising laterally from the secondary rhizoid.
Fig. 8. A secondary frond arising laterally from the primary rhizoid with two secondary rhizoids arising from its lower margin.
Figs 9–10. Further developed secondary fronds than Fig. 8, arising laterally from the primary rhizoid.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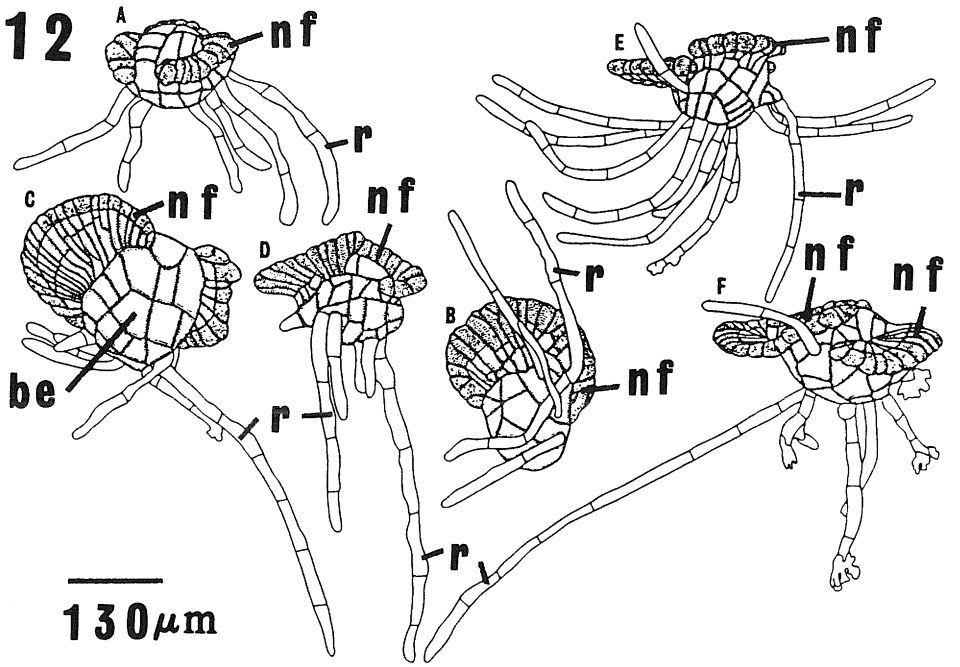
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When the secondary rhizoids attain the length of more than 10 cells, development of the tertiary fronds is initiated from them in the same manner as the one in the formation of the secondary fronds (Fig. 7), and then tertiary rhizoids develop in the same manner as the one in the formation of the secondary ones.

Each new frond formed by vegetative propagation finally detaches from the rhizoid or marginal filament from which it originated and becomes an independent plant.

Distromium decumbens is related to *Zonaria diesingiana* J. AGARDH (KUMAGAE 1977) in having vegetative propagation occurring from rhizoid and frond margin, but it is distinct from those two known taxa of Dictyotaceae in the initial position of vegetative propagation such as *Dictyopteris divaricata* (OKAMURA) OKAMURA (TOKIDA, MASAKI and YABU 1953) which has the initiation of vegetative propagation only from rhizoid, *Pachydictyon coriaceum* (HOLMES) OKAMURA (KUMAGAE 1977) which has the initiation of vegetative propagation only from frond margin.

Vegetative propagation of this alga similar to the one observed in culture was detected by the present writer in nature during the seasons of the year ranging from early summer to early winter at the depth ranging from 15 to 40 m in the vicinity of the Oki Islands.

The fact that there is rich vegetation of this alga in the deep-water in the vicinity of the Oki Islands in every year is considered to be explained by its remarkable character of the vegetative propagation as well as the production of spores.

Spore germination

Discharged spores of this alga are angular first then become subspherical, granular and measure about 130 μm in diameter (Fig. 11A). The first division of

Figs 11–12. *Distromium decumbens* (OKAMURA) LEVRING.
Fig. 11. Early stages of spore germination.
Fig. 12. Later stages of spore germination showing one (A–D) or two (E–F) new young fronds arising from embryos.

Abbreviations used in Figures

be	body of embryo
f	filamentous projection
isf	initial cell of secondary frond
isr	initial cell of secondary rhizoid
nf	new frond
nfi	new frond initial
pr	primary rhizoid
r	rhizoid
sf	secondary frond
sp	discharged spore
sr	secondary rhizoid
tf	tertiary frond

discharged spore is transverse (Fig. 11B). The lower cell elongates and gives rise to a rhizoid fundamentally (Fig. 11C) but more than one rhizoids are observed to be formed from lower cells of the body of embryos (Figs 11N, Q–R, 12). Two-celled body of embryo repeates the division to form a multicellular body of embryo which produces a fan-shaped new frond terminally (Figs 11I–J) or subterminally (Figs 11O, Q–R, 12). The fan-shaped new frond has a meristem along its distal margin (Figs 12B–F).

Distromium decumbens is related to those 5 known taxa of Dictyotaceae in that the new frond has more than one meristematic cells along its distal margin such as *Dictyopteris prolifera* (KUMAGAE 1968), *D. undulata* (KUMAGAE 1972), *Spathoglossum pacificum* (KUMAGAE 1972), *Stypopodium zonale* (KUMAGAE 1976) and *Zonaria diesingiana* (KUMAGAE and INOH 1964). It is however, distinct from those 6 known taxa of Dictyotaceae of which new fronds have a single apical cell such as *Dictyota dichotoma* (HUDSON) LAMOUROUX (COHN 1865, NISHIBAYASHI and INOH 1959), *Pachydictyon coriaceum* (HOLMES) OKAMURA (KUMAGAE 1968), *Padina crassa* YAMADA (KUMAGAE 1976), *Padina gymnospora* (KÜTZING) VICKERS (MSHIGENI and MKWIZU 1978), *Padina japonica* YAMADA (NISHIBAYASHI and INOH 1959) and *Padina pavonia* J. AGARDH (CARTER 1927). Two new fronds are observed to be formed from a single embryo which is considered to be developed from a sporangial mother cell (Figs 11Q, 12E–F).

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