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On a New Species of *Griffithsia* (Rhodophyta, Ceramiaceae), *G. okiensis*, from Japan

Mitsuo KAJIMURA
Marine Biological Station, Shimane University, Kamo, Saigo, Oki-gun, 685 Japan
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Griffithsia okiensis sp. nov. is described herein from the material collected in the Oki Islands, Shimane Prefecture. The new species is considered to be unique in the following 3 characters: 1, the female fertile segment has 1–2 fertile axes; 2, the female fertile axis consisting of 1–2 axial cells is provided with 3 pericentral cells on the apical cell; and 3, the procarp has a pair of carpogonial branches arised from the supporting cell.

Key Index Words: Griffithsia okiensis; *Ceramiaceae*; *Rhodophyta*; *1–2 female fertile axes*; *1–2 female fertile axial cells*; *3 pericentral cells*; *procarp with a pair of carpogonial branches.*

Introduction

The author was fortunate enough to discover this minute new red alga from among the algal collections made in the Oki Islands, Shimane Prefecture, for the purpose to study the distribution of marine algae in the southwestern part of the Japan Sea under the influence of Tsushima Warm Current, a branch of Kuroshio Current, which has a significant influence upon algal vegetations.

The alga under consideration was very frequently found growing on rocks, but also on algae such as *Cladophora ohkuboana* and *Corallina pilulifera*, or on animals such as *Halichondria* sp. and Gastropoda shells at low-tide-level in shaded places.

Mature specimens of the red alga could be collected abundantly in the past 3 years since 1979, so detailed studies on structures of reproductive organs were possible, and its peculiar procarp system led the author to a conclusion that it should be treated as a new species of *Griffithsia*.

Materials and methods

Materials of mature male, female and tetrasporic specimens used for the present study were collected by the author at Kamo Bay and Takatori in the Oki Islands, Shimane Prefecture, every month except May, June and November, as shown in the following list.

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Abbreviations Used in Figures and Table 1

1, 2, 3, 4	cells of carpogonial branch
a	apical cell
a. sg	apical segment
aux	auxiliary cell
ca	carposporangium
c. b	carpogonial branch
d. st. b	dwarf sterile branchlet
f. ax	fertile axial cell
fu	fusion cell
g. c	gonimoblast cell
gl	gonimolobe
i. c. f. ax	initial cell of fertile axis
inv. c	involucral cell
p	pericentral cell
rh	rhizoid
sa	subapical cell
sm	spermatium
sp	spermatangium
sp. m	spermatangial mother cell
sp. sd	spermatangial stand
sp. sd. i	spermatangial stand initial
stk	stalk cell
st. p	sterile pericentral cell
su	supporting cell
su. st	sterile cell on the supporting cell
t	tetrasporangium
tr	trichogyne
t. sd. i	tetrasporangial stand initial
y. er. b	young erect branch
y. t	young tetrasporangium

List of materials

No.	Date	Locality	Substratum	Maturity
OS9868	Mar. 2, 1979	Kamo Bay	on rocky bottom	♂, ♀, ☮
OS9869	Apr. 4, 1979	Kamo Bay	on rocky bottom	♂, ♀, ☮
OS9870	Apr. 27, 1979	Kamo Bay	on rocky bottom, *Cladophora ohkuboana*	♂, ♀, ☮
OS9871	Aug. 15, 1979	Kamo Bay	on rocky bottom, *Corallina pilulifera*	♂, ♀, ☮
OS9872	Sep. 25, 1980	Takatori	on rocky bottom, *Cladophora ohkuboana*	♀, ☮
OS9873	Sep. 26, 1980	Takatori	on rocky bottom	♀, ☮

OS9874	Oct. 17, 1980	Kamo Bay	on rocky bottom, shell of Gastropoda	♂, ♀, ☮
OS9875	Oct. 18, 1980	Kamo Bay	on rocky bottom	♂, ♀, ☮
OS9876	Jan. 9, 1981	Kamo Bay	on rocky bottom, *Halichondris* sp.	♂, ♀, ☮
OS9877	Jan. 20, 1981	Kamo Bay	on rocky bottom, *Halichondris* sp.	♂, ♀, ☮
OS9878	Jan. 29, 1981	Kamo Bay	on rocky bottom	♂, ♀, ☮
OS9879	Feb. 4, 1981	Kamo Bay	on rocky bottom	♂, ♀, ☮
OS9880	Feb. 7, 1981	Kamo Bay	on rocky bottom	♂, ♀, ☮
OS9881	Jul. 7, 1981	Kamo Bay	on rocky bottom	♂, ♀, ☮
OS9882	Dec. 28, 1981	Kamo Bay	on rocky bottom	♂, ♀, ☮
OS9883	Feb. 2, 1982	Kamo Bay	on rocky bottom	♂, ♀, ☮

Fresh specimens and specimens preserved in formalin-seawater and stained with 1 percent aniline blue, were used for this study.

Tetraspores, discharged from a mature tetrasporophyte collected in Kamo Bay on January 9, 1981, were cultured in filtered sterilized seawater kept at 14°C and constant 600 lux under a cool-white-fluorescent lamp.

Griffithsia okiensis sp. nov.

Thallus membranaceus, mollis, erectus, 3 mm-1 cm alt., fasciculatus, in quoque segmento eodem in plano dichotome ramosus, colore ruber. Pars basalis saepe implicata. Rhizoideum multicellulare, e cellulis inferioribus nascens, in pseudodiscum terminans, ramos erectos saepe efficiens. Segmentum cylindricum ad clavatum 50–500 μm diam., 2–3 plo longius quam diam. Chromatophorum discoideum. Trichoblasta nulla.

Planta dioecia. Segmentum femineum fertile extrema in parte effectum, 1–2 axes fertiles, 1–3 ramulos nannos steriles atque cellulas involucrales e margine superiore directe enascentes, habens. Axis fertilis unum procarpum, qui ex 1–2 cellulis axialibus constat, habens, 3 cellulis pericentralibus e cellula apicali enascentibus. Una illarum trium cellularum pericentralium cellulam sustentinentem facta quae par ramorum carpogonialium quadricellularium, atque unam cellulam sterilem atque unam cellulam auxiliarem post fecundationem efficit. Unum duorum carpogoniorum fecundatorum cellulae auxiliari directe coniungens. Aliquae filamenta gonimoblastica e cellula auxiliari postquam carpogonio fecundato coniunxerunt enascentia. Cellula apicalis atque cellula sustens atque cellula auxiliaris atque cellulae gonimoblasticae inferiores magnam cellulam coalescentem, quae multa initia gonimoblastica efficit, formantes. Quasi omnes cellulae gonimolobi nisi cellulae eius inferiores carposporangia factae. Carposporangia matura 30–90 × 30–40 μm.

Segmentum fertile masculum ad secundum, tertium vel quartum e terminali situm, multos racemos spermatangiales atque cellulas involucrales e margine eius superiore directe enascentes praebens. Racemus spermatangialis sympolialiter ramosus, multas cellulas pericentrales ad omne segmentum quae in ramulos laterales evolvunt habens. Cellulae-matres spermatangiales in ramulum lateralem terminaliter aut subterminaliter formatae, 1–4 spermatangia efficientes.

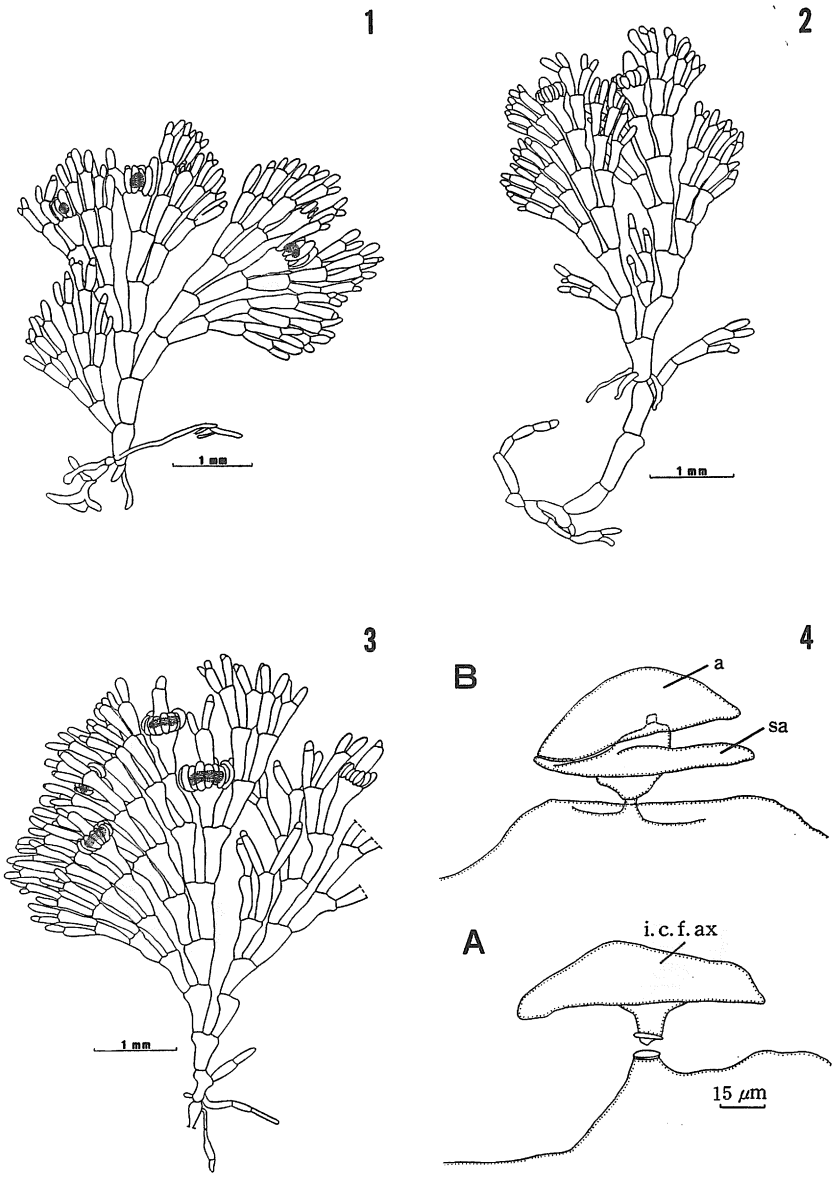
Segmentum fertile tetrasporophyti necnon ad secundum, tertum vel quartum e terminali situm, et multos racemos tetrasporangiales et cellulas involucrales e margine eius superiore directe enascentes praebens. Cauliculo-cellula multa tetrasporangia spherica ad subspherica quae longam foveo-colligationem diverse directam habent, efficiens. Tetrasporangia matura 24–60 × 40–100 μm, tetrahedrice divisa. Germinatio tetrasporae atque carposporae ad typum erectum pertinens.

Thallus membranous, soft, erect, 3 mm-1 cm high, fasciculate, composed of segment-shaped cells, branching dichotomously in one plane (Figs. 1–3), scarlet in color. Rhizoid frequently entangled, multicellular, arising from lower thallus cells, terminating in pseudodisc, producing erect branches frequently (Fig. 21). Segment cylindrical to clavate, 50–500 μm in diameter, 2–3 times as long as diameter. Chromatophores discoid (Fig. 16). Trichoblast absent.

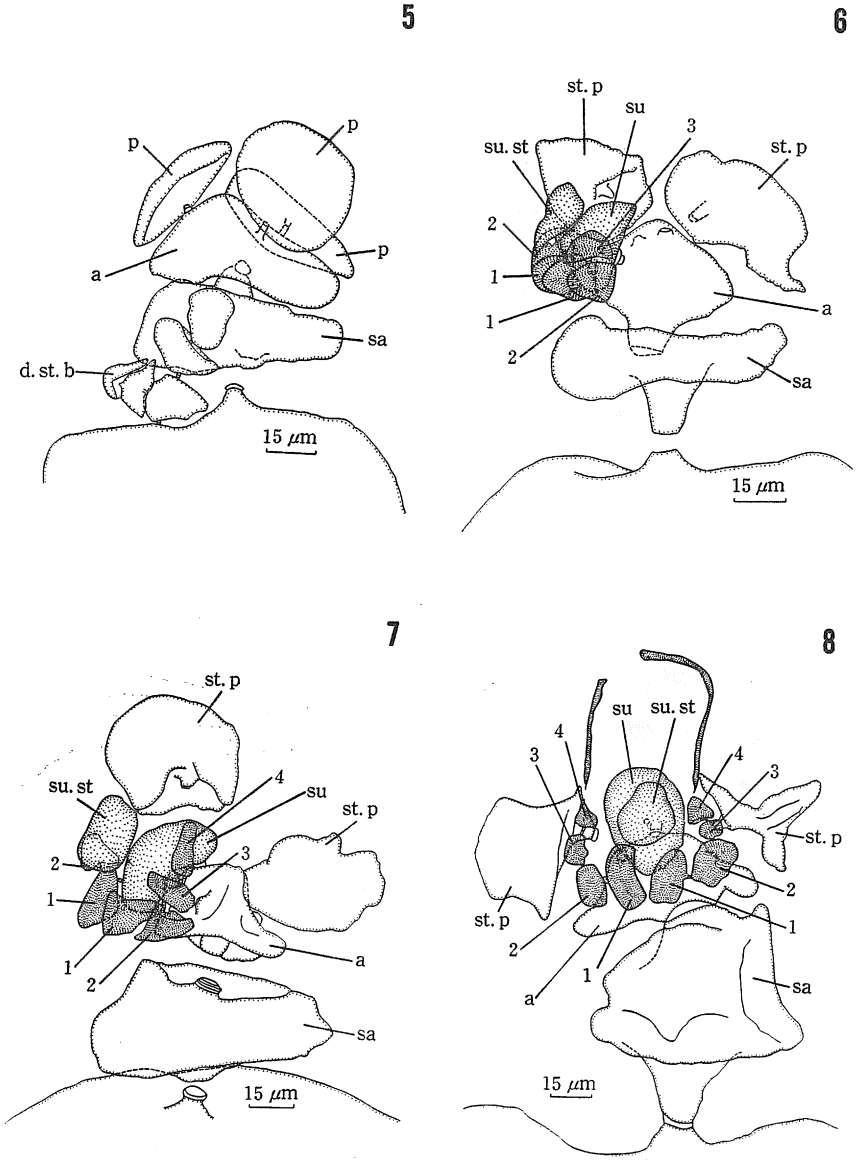
Plant dioecious. Female fertile segment (Fig. 27) terminal, with 1–2 fertile axes, 1–3 dwarf sterile branchlets (Fig. 5) and involucral cells arising directly from its upper margin. Fertile axis with one procarp, consisting of 1–2 axial cells with 3 pericentral cells arising from the apical cell (Figs. 4–5, 23–25). One of the pericentral cells become supporting cell which produces a pair of 4-celled carpogonial branches (Figs. 6–9, 26), one sterile cell, and after fertilization one auxiliary cell (Figs. 10–11). One of the 2 fertilized carpogonia connects directly with auxiliary cell (Figs. 10–11). Auxiliary cell producing several gonimoblast filaments after connected with fertilized carpogonium (Fig. 11). Apical cell, supporting cell, auxiliary cell and lower gonimoblast cells fuse with each other to form a large fusion cell which gives rise to many gonimolobe initials (Fig. 12). Nearly all cells of gonimolobe except the lowermost ones, become carposporangia, which are 30–90 × 30–40 μm when matured.

Male fertile segment (Fig. 28) is found situated at the 2nd, 3rd or 4th positions from the terminal, producing many spermatangial stands and involucral cells directly from its upper margin (Figs. 13–14, 17). Spermatangial stand branching sympodially, producing at each segment many pericentral cells which develop into lateral branchlets (Fig. 15). Spermatangial mother cells formed terminally or subterminally on lateral branchlet, producing 1–4 spermatangia (Fig. 15).

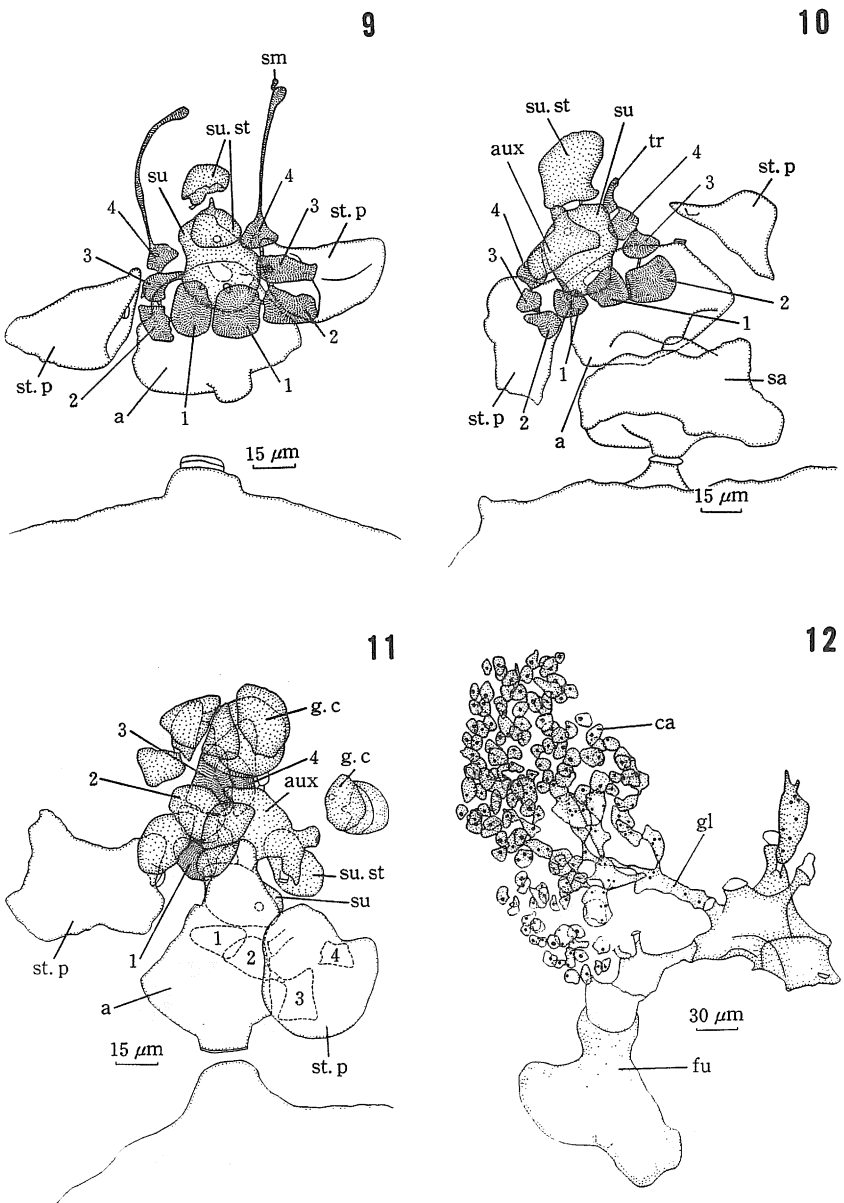
Fertile segment of tetrasporophyte (Fig. 29) is also situated at the 2nd, 3rd or 4th positions from the terminal, producing many tetrasporangial stands and involucral cells directly from its upper margin (Figs. 18–19). Spherical to subspherical tetrasporangia possessing a long plasmic pit connection produced abundantly in various



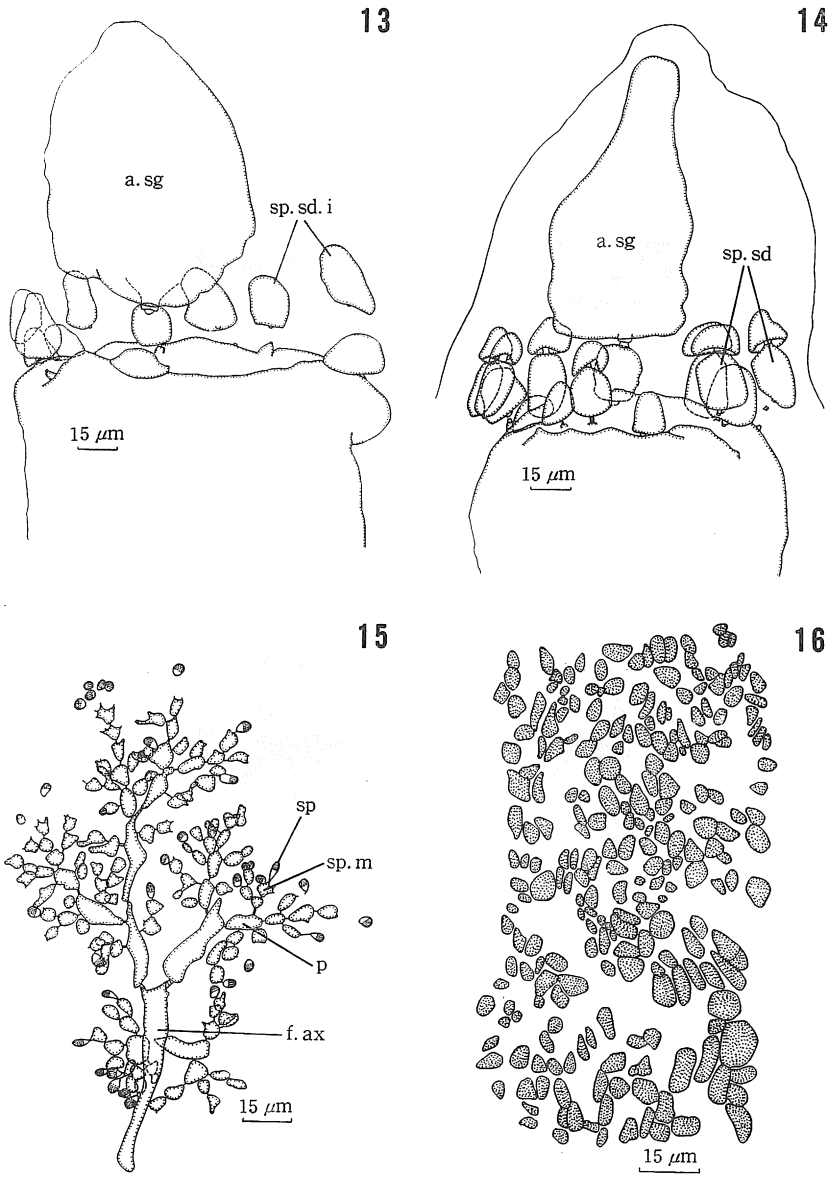
Figs. 1–4. *Griffithsia okiensis* sp. nov. 1, Habit of the holotype female specimen (OS9877) collected at Kamo Bay on January 20, 1981; 2, Habit of the holotype male specimen (OS9877) collected at Kamo Bay on January 20, 1981; 3, Habit of the holotype tetrasporic specimen (OS9877) collected at Kamo Bay on January 20, 1981; 4, Young female fertile axes, showing an initial cell of the female fertile axis (A) and 2-celled stage (B).



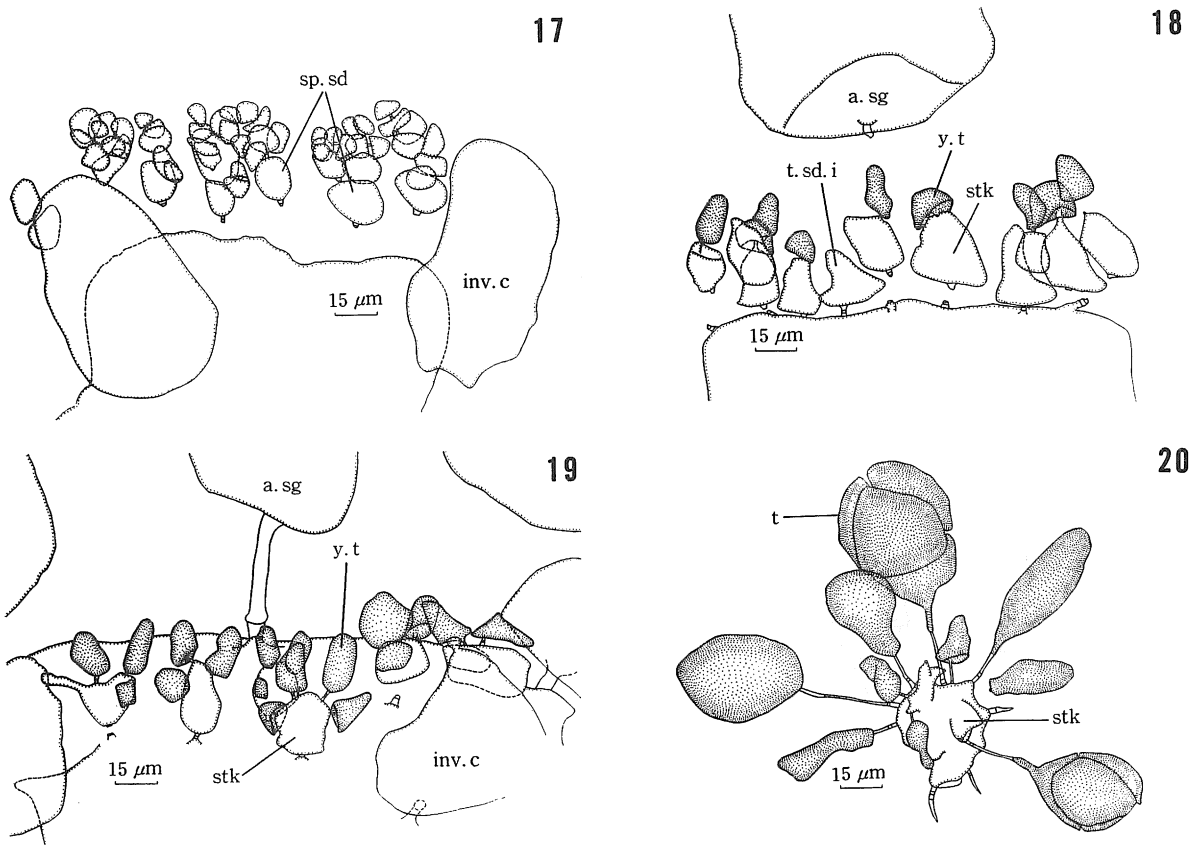
Figs. 5–8. *Griffithsia okiensis* sp. nov. 5, Mature female fertile axis and a dwarf sterile branchlet; 6–7, Young stages in formation of procarp; 8, Mature procarp system formed on the female fertile axis with 2 axial cells.



Figs. 9–12. *Griffithsia okiensis* sp. nov. 9, Mature procarp system formed on the female fertile axis with only one axial cell; 10, Post-fertilization stage, whowing direct connection of auxiliary cell and one of the 2 fertilized carpogonia; 11, Post-fertilization stage, showing some gonimoblast cells originated from auxiliary cell; 12, Part of a mature carposporophyte, showing a comparatively young gonimolobe.



Figs. 13–16. *Griffithsia okiensis* sp. nov. 13–14, Young stages in formation of spermatangial stands; 15, Longitudinal section of mature spermatangial stands; 16, Chromatophores in a vegetative segment.



Figs. 17–20. *Griffithsia okiensis* sp. nov. 17, Young stage in formation of spermatangial stands; 18–19, Young stages in formation of tetrasporangial stands; 20, Mature tetrasporangial stand.

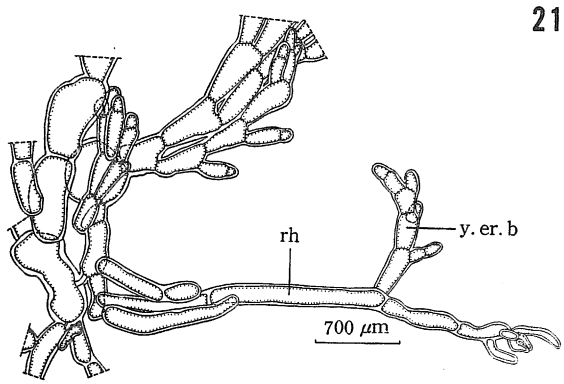


Fig. 21. *Griffithsia okiensis* sp. nov. Vegetative propagation of thallus from rhizoid.

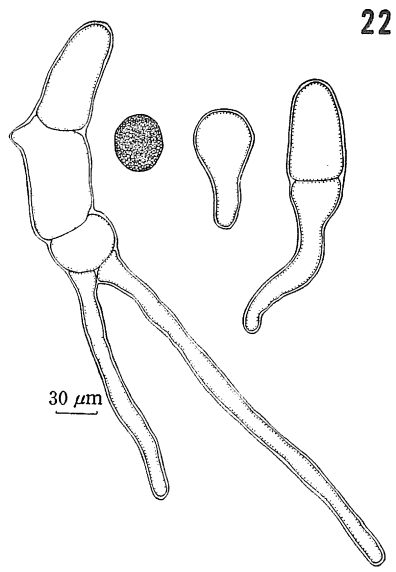
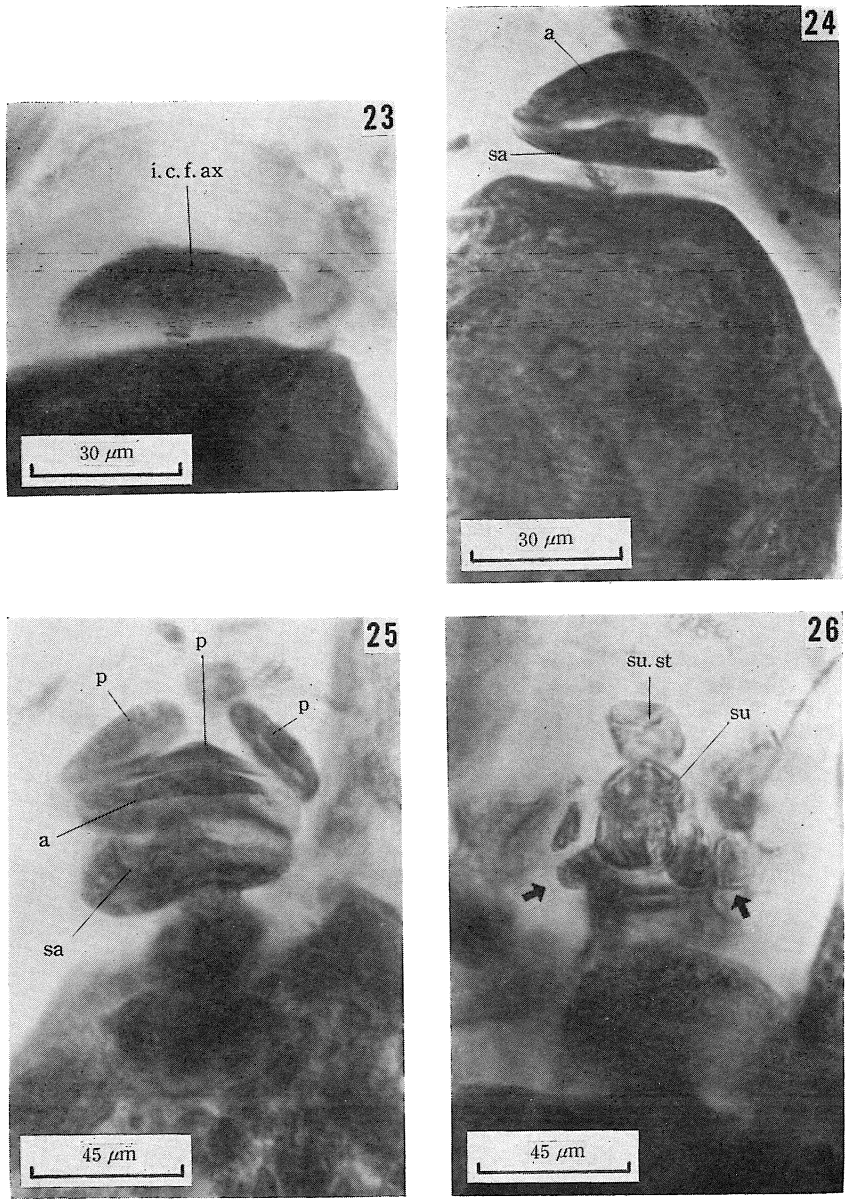
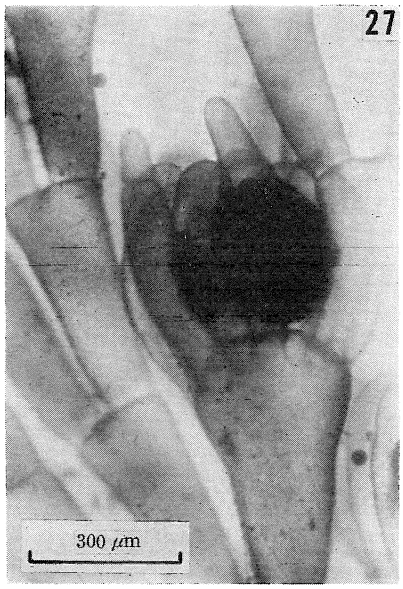
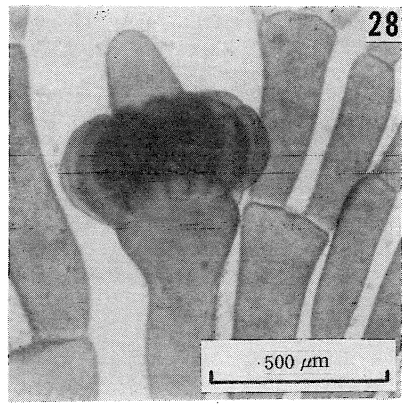


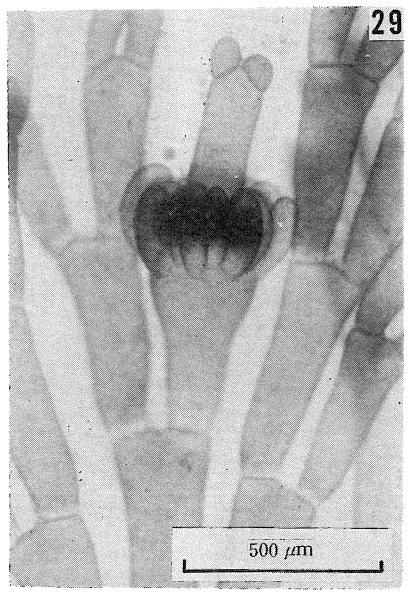
Fig. 22. *Griffithsia okiensis* sp. nov. Tetrasporelings.



Figs. 23–26. *Griffithsia okiensis* sp. nov. 23–25, Stages in formation of female fertile axis in the specimens (OS9869) collected at Kamo Bay on April 4, 1979 and preserved in formalin-seawater; 26, Mature procarp system in a specimen (OS9869) collected at Kamo Bay on April 4, 1979 and preserved in formalin-seawater, showing 2 carpogonial branches arising from one supporting cell pointed by arrow.







Figs. 27–29. *Griffithsia okiensis* sp. nov. 27, Mature female fertile segment in a fresh specimen (OS9876) collected at Kamo Bay on January 9, 1981; 28, Mature male fertile segment in a fresh specimen (OS9876) collected at Kamo Bay on January 9, 1981; 29, Mature tetrasporic segment in a fresh specimen (OS9876) collected at Kamo Bay on January 9, 1981.

directions from stalk cell (Fig. 20). Mature tetrasporangia, 24–60 × 40–100 μm, divided tetrahedrally. Germination mode of tetraspore and carpospore belonging to erect type (Fig. 22).

Japanese name: Oki-kazashigusa (nom. nov.).

Type locality: Kamo Bay, the Oki Islands, Shimane Prefecture.

Holotype: OS9877.

Distribution: Kamo Bay and Takatori, Dōgo District, the Oki Islands, Shimane Prefecture.

Table 1. Comparison of *Griffithsia okiensis* sp. nov. and its allied species.

Species	Height (cm)	Trichoblast	Involucral cells in tetrasporic plant	Female fertile axis No.	Axial cell	Procarp
G. okiensis sp. nov.	0.5–1	Absent	Arising from fertile segment	1–2	1–2 with 3 p	2 c. b per su
G. japonica (OKAMURA, 1930)	3–6	Absent	Arising from fertile segment	1	3 with 3 p	1 c. b per su
G. pacifica (KYLIN, 1925)	3–5	Present	Arising from stalk cell	2	2 with 3 p	1 c. b per su
G. venusta (YAMADA, 1944)	1	Absent	Arising from stalk cell	1	3 with 2 p	1 c. b per su

Discussion

Griffithsia okiensis is considered to be different drastically from such allied species as *G. japonica* (OKAMURA 1930), *G. pacifica* (KYLIN 1925), and *G. venusta* (YAMADA 1944), in the following aspects: (1) it has 1–2 female fertile axes per one fertile segment, (2) its fertile segment consists of 1–2 axial cells and 3 pericentral cells, and (3) its procarp has a pair of carpogonial branches per one supporting cell. The procarp of this type in which a pair of carpogonial branches are produced from a single supporting cell is considered to be peculiar to the present new species as it is unknown not only to the genus *Griffithsia* but also to all the known genera in the family Ceramiaceae.

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References

OKAMURA, K. 1930 Icones of Japanese Algae Vol. VI. Kazama Shobō, Tokyo: 1–96.

KYLIN, H. 1925 The Marine Algae in the Vicinity of the Biological Station at Friday Harbor, Wash.. Lunds Univ. Årsskr. . N. F. Avd. 2. Bd **21**. Nr 9: 1–87.

YAMADA, Y. 1944 Notes on Some Japanese Algae X. Sci. Pap. Inst. Algol. Res., Fac. Sci., Hokkaido Imp. Univ., **3** (1): 11–25.