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Morphological observations on *Acrothrix gracilis* KYLIN (Chordariales, Phaeophyta) newly found in Japan[1),2)]

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Hiroshi KAWAI. Morphological observations on *Acrothrix gracilis* KYLIN (Chordariales, Phaeophyta) newly found in Japan. Jap. J. Phycol. 31 : 167-172.

Morphological observations are made on the plant identified as *Acrothrix gracilis* KYLIN (1907), newly found at Akkeshi, Pacific coast of Hokkaido. Among the morphological features, the length of assimilatory filaments, shape and number of their cells are shown to be remarkably variable mainly according to the age of the plant. The assimilatory filaments are relatively long, isodiametric and composed of symmetric cells in younger plants, whereas in mature plants, they are relatively short, composed of asymmetric upper cells and symmetric lower cells and often unisodiametric. Among the 4 species described in the genus until now, *A. pacifica* was the only species reported in Japan and is clearly distinguished from the others in the morphological features of assimilatory filaments. *A. novae-angliae* and *A. norvegica* resemble *A. gracilis*, the type species of the genus, in their habits and morphological features of assimilatory filaments. A taxonomic reexamination of these species seems to be needed.

Key Index Words: Acrothrix; A. gracilis; *Chordariales*; *morphology*; *phytogeography*; *Phaeophyta*; *taxonomy*.

Acrothrix gracilis KYLIN (1907) was newly collected at Akkeshi, Pacific coast of Hokkaido. In the genus *Acrothrix*, *A. pacifica* OKAMURA et YAMADA was the only species known in Japan until now. Morphological observations on the plant of *A. gracilis* and a taxonomical discussion are presented.

Materials

The specimens observed were collected in Akkeshi (43°02′N, 144°52′E) at Cape Aikappu on June 28, 1980 and at Cape Aininkappu on June 29, 1980 and June 27, 1982. Some specimens were dried on herbarium sheets, and others were preserved in 10% formaldehyde-seawater for morphological observations with the light microscope.

A comparison with *Acrothrix pacifica* was also made. The materials of *A. pacifica*, which were also preserved in 10% formaldehyde-seawater, were collected at the following localities in Japan:

July 20, 1978, Abashiri (Okhotsk coast of Hokkaido); July 11, 1982, Ofuyu, July 6, 1982, Oshoro (Japan Sea coast of Hokkaido); May 10, 1982, Kikonai (In Hokkaido facing Tsugaru Strait); July 3, 1982, Miyako, July 3, 1980, Ohtsuchi (Pacific coast of northeastern Honshu); May 16, 1982, Mifunezaki (Japan Sea coast of Noto Peninsula).

1) Dedicated to Professor Munenao KUROGI on the occasion of his academic retirement.

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Results

Morphological observations on *Acrothrix gracilis*

The plants grow on rocks or on *Corallina pilulifera* POSTELS et RUPRECHT, together with *Eudesme virescens* (CARMICH.) J. AGARDH and *Chordaria flagelliformis* (MÜLL.) C. AGARDH in the upper subtidal zone to 1 meter deep under M. L. L. in rather sheltered areas. The thalli (Fig. 1; 2, a-d) are irregularly alternately branched to 2-3 orders, up to about 20 cm in height and 0.5 mm in diameter, not so slimy but smooth and rather tough, and yellowish in the living condition. They are solid in the upper part but hollow in the middle or lower parts.

The thallus is constructed of a single central axial filament with trichothallic growth, medullary layer and cortical layer. Cells of central axial filaments are long cylindrical, nearly hyaline and measure 20-43 μm and 15-30 μm in long and short diameters in cross section of the upper part of the thallus (Fig. 3c). Trichothallic hairs

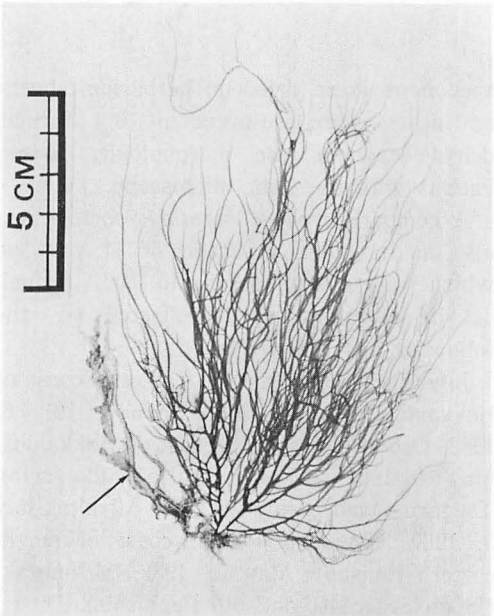

Fig. 1. *Acrothrix gracilis* KYLIN at Akkeshi. Habit, growing on *Corallina pilulifera*. Arrow shows *Eudesme virescens*.

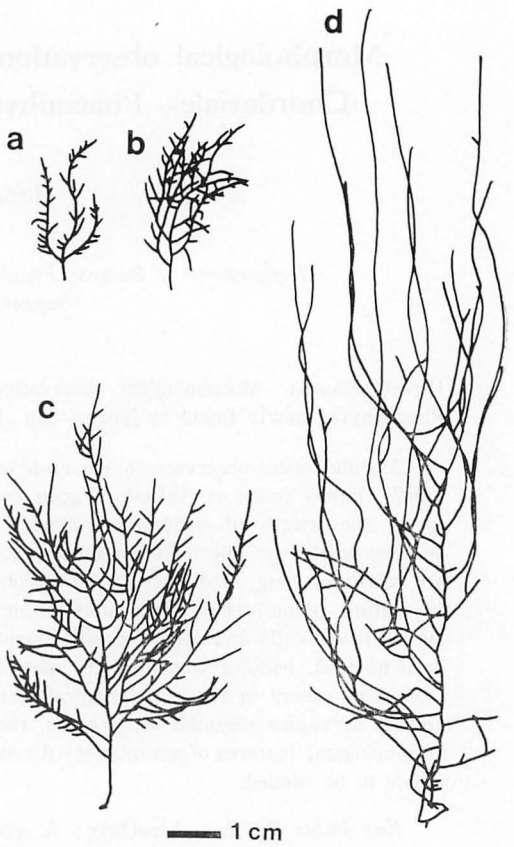

Fig. 2. *Acrothrix gracilis* KYLIN at Akkeshi, showing branching; a, b, young plants having irregular branchlets; c, d, mature plants.

measure 8-13 μm in diameter. The medullary layer is composed of 2-3 layers of large hyaline cells (Fig. 3, a-d; 4, b). Their cells measure 65-103 μm and 50-90 μm in long and short diameters in cross section. The cortical layer is composed of cortical cells, assimilatory filaments, lateral hairs and unilocular sporangia (Fig. 3, a, b, d; 4, b). Cortical cells are roundish and 8-48 μm in diameter in cross section, containing a few chloroplasts.

Assimilatory filaments are formed from a central axial filament near the apex and from cortical cells in the middle and lower parts of the thallus. Cells of the assimilatory filaments contain several chloroplasts. The number of cells and the shape of the assimilatory filaments are considerably

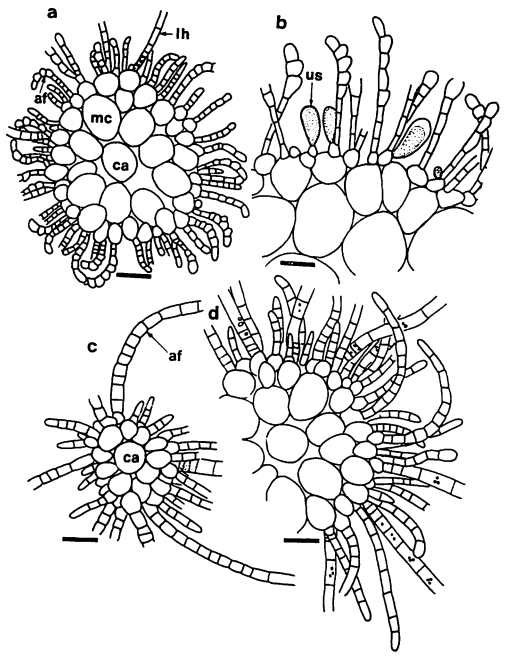

Fig. 3. *Acrothrix gracilis* KYLIN at Akkeshi. a, cross section of solid part of mature plant; b, cross section of hollow part of mature plant, showing asymmetric assimilatory filaments and unilocular sporangia; c, cross section of solid part of young plant showing long symmetric assimilatory filaments; d, cross section of upper part of young plant. (af, assimilatory filament; ca, central axial filament; lh, lateral hair; mc, medullary cell; us, unilocular sporangium) Rule: 20 μm.

variable mainly according to the age of the plant.

In mature plants, as shown in Figs. 3a, 3b, 4a, 4b, the assimilatory filaments are relatively short, 7-12 celled and 43-120 μm in length. There are two types of assimilatory filaments, symmetric ones and asymmetric ones in shape. Symmetric assimilatory filaments are more often observed in the upper part of the thallus, simple and nearly isodiametric throughout the length. The terminal cells of these filaments measure 10-15 μm in length and 5-6 μm in width. The lowermost cells of them measure 4-6 μm in length and 5-8 μm in width. On the other hand, asymmetric assimilatory filaments are more often observed in middle or lower parts of the thallus (Fig. 3, a-b). The upper part of the asymmetric assimilatory filaments are usually curved and their upper cells are often considerably swollen to one side. Their terminal cells measure 9-15 μm in length and 4-8 μm in width. The lower cells of the filaments are usually cylindrical and narrower than the other cells. The lowermost cells of the asymmetric assimilatory filaments measure 6-13 μm in length and 3-5 μm in width.

But the assimilatory filaments of young plants, which have many irregular branchlets near the apex of the thallus (Fig. 2, a-b; 4, c), are often very long, 7-19 celled and 55-300 μm in length. They are usually isodiametric, simple and composed of cylindrical cells. They often curve adaxially to envelop the apex in the upper part of the thallus (Fig. 3, c-d; 4, c-d). The assimilatory filaments are nearly uniform in morphology throughout the thallus of a young plant. Asymmetric assimilatory filaments are not observed. Their terminal cells measure 11-25 μm in length and 5-10 μm in width. Their lowermost cells measure 5-10 μm in length and 5-9 μm in width.

Phaeophycean hairs are abundant in young plants and measure 8-13 μm in diameter (Fig. 3d). They are also present in mature plants but fewer than in young plants (Fig. 3a).

Unilocular sporangia are sessile on the basal cells of assimilatory filaments, or on the cortical cells with a stalk cell and obovoid in shape (Fig. 3b). They measure 28-45 μm in length and 15-29 μm in width. The length/width ratio of unilocular sporangia is about 1.3-2.3. Plurilocular sporangia are not observed.

Morphological observations on *Acrothrix pacifica*

All the materials observed were epiphytic on *Chorda filum* (LINN.) STACKHOUSE. The thalli are irregularly alternately branched, yellowish brown and up to 8 cm in height and 0.6 mm in diameter.

The structure of the thallus agrees well with the original description by YAMADA

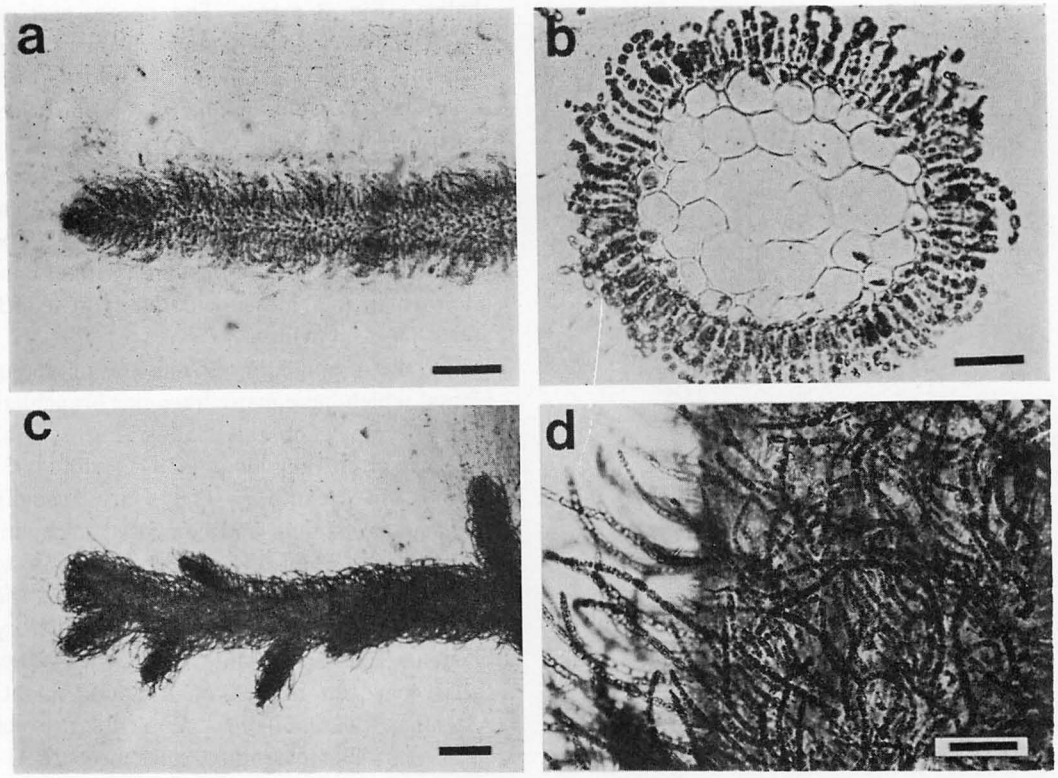

Fig. 4. *Acrothrix gracilis* KYLIN at Akkeshi. a, surface view of upper part of mature plant; b, cross section of middle part of mature plant, showing short asymmetric assimilatory filaments and unilocular sporangia; c, surface view of upper part of young plant having branchlets, showing long assimilatory filaments enveloping apex; d, surface view of lower part of young plant, showing long assimilatory filaments. Rule: a, 100 μm b, d, 50 μm, c, 200 μm.

(1932) and with the report of the species by INAGAKI (1958). Assimilatory filaments of *A. pacifica* are generally isodiametric and symmetric irrespective of the age or the part of the plant. Asymmetric assimilatory filaments as observed in the plant of *A. gracilis* are not observed. In mature plants, the assimilatory filaments are composed of 4-12 cells, 35-168 μm in length. Terminal cells of the filaments measure 10-38 μm in length and 6-20 μm in width. Their lowermost cells measure 10-28 μm in length and 6-15 μm in width.

Unilocular sporangia are obovoid, 30-55 μm in length and 23-45 μm in width. The length/width ratio of the unilocular sporangia is about 1.1-1.7. Plurilocular sporangia are not observed.

Discussion

The plant belongs to the genus *Acrothrix* in KYLIN (1907), as it has a single central axial filament with trichothallic growth, uniseriate assimilatory filaments and oniy unilocular sporangia as reproductive organ.

In the genus *Acrothrix*, four species have been described. They are the type, *A. gracilis* KYLIN (1907), *A. novae-angliae* TAYLOR (1928) and *A. norvegica* LEVRING (1937) from North Atlantic Ocean and *A. pacifica* OKAMURA et YAMADA (YAMADA 1932) from North Pacific Ocean.

Among these species, the plant at Akkeshi is most similar to the type species, *A. gracilis*. As seen in Table 1, it agrees with the species in habitat, height and diameter of thallus, diameter of lateral hair and size

Table 1. Morphological comparison of *Acrothrix gracilis* at Akkeshi and *A. gracilis* in KYLIN (1907, 1947).

		A. gracilis at Akkeshi			*A. gracilis* in KYLIN (1907, 1947)	
habitat		epilithic or on *Corallina* sp.			epilithic	
branching (orders)		2-3			1-2	
height of thallus (cm)		<20			10-40	
diameter of thallus (mm)		<0.5			0.5-1	
		a	b	c	d	e
assimilatory filament	length (μm)	55-300	43-88	53-120	—	—
	number of cells	7-19	7-10	7-12	7-10	4-7
	length × width of terminal cell (μm)	11-25×5-10	10-15×5-6	9-15×4-8	12-18×6-9	—×6-10
	length × width of lowermost cell (μm)	5-10×5-9	4-6×5-8	6-13×3-5	6-9×6-9	—×3-5
diameter of lateral hair (μm)		8-13			7-9*	
size of unilocular sporangium (μm)		28-45×15-29			35-50×18-22	

a, young plant, b, symmetric assimilatory filament in mature plant, c, asymmetric assimilatory filament in mature plant, d, primary assimilatory filament, e, secondary assimilatory filament.
* measured from Figs. 22 & 23 in KYLIN (1907).

of unilocular sporangia. KYLIN (1907, 1947) reported two types of assimilatory filaments, the primary one (formed from the central axial filament, symmetric) and the secondary one (formed from the cortical cells, asymmetric composed of thin lower cells and unilaterally swollen upper cells). Such characteristic assimilatory filaments are also observed in the mature plant at Akkeshi. The cell sizes of symmetric and asymmetric assimilatory filaments of the mature plant at Akkeshi also agree with those of the "primary" and "secondary" ones of *A. gracilis* in KYLIN. However, some differences are seen in branching of the thallus and the number of cells of assimilatory filaments between the two. The branching of the plant at Akkeshi is usually denser than in *A. gracilis* in KYLIN. In addition, the assimilatory filaments are a little longer in the plant at Akkeshi. But these differences seem to be variations within the same species. So, the plant at Akkeshi is identified as *Acrothrix gracilis* KYLIN.

Judging from the descriptions by YAMADA (1932) and INAGAKI (1958) and my observation in this paper, *A. pacifica* is clearly distinguished from *A. gracilis* especially in the morphology of the assimilatory filaments. The assimilatory filaments of *A. pacifica* are wider (the terminal cells measure 8-15 μm in diameter by YAMADA 1932) than those of *A. gracilis*. In addition, asymmetric assimilatory filaments as seen in *A. gracilis* do not occur in *A. pacifica*.

Acrothrix novae-angliae was reported from the Atlantic coast of North America by TAYLOR (1928), who distinguished it from *A. gracilis* in having denser branching and subspherical unilocular sporangia. LEVRING (1937) suggested that *A. novae-angliae* might represent a well branched form of *A. gracilis*. *A. norvegica* was described from Norway by LEVRING (1937) and characterized

by having numerous irregular branchlets in the upper part of the thallus and long assimilatory filaments attaining 15 cells in length. Asymmetric assimilatory filaments were not reported in this species. In these features, *A. norvegica* resembles the young plants of *A. gracilis* at Akkeshi. Considering the variations of branching and the diversity in morphology of assimilatory filaments in *A. gracilis*, it seems to me that a reexamination of the taxonomic interrelationships among *A. novae-angliae*, *A. norvegica* and *A. gracilis* is needed.

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川井浩史： 日本新産褐藻 *Acrothrix gracilis* KYLIN（キタニセモズク；新称）の形態学的観察

北海道の太平洋沿岸，厚岸で日本新産の *Acrothrix gracilis* KYLIN を採集し，その形態学的観察を行った。本種の同化糸は主に生長の段階によりその長さ，細胞の形態と長さが著しく異なる。若い藻体では同化糸は比較的長く，等径で相称の細胞からなるが，成熟した藻体では比較的短く，非相称な上部の細胞と相称な下部の細胞からなりしばしば不等径である。本属ではこれまでに4種が記載されており，*A. pacifica* だけが本邦で報告されていた。これらのうち，*A. pacifica* は同化糸の形状で他と明らかに区別されるが *A. novae-angliae* と *A. norvegica* はこの属のタイプ種の *A. gracilis* とその外観，同化糸の形状が類似し，これら三種の分類学的な再検討が必要であると考える。(060 札幌市北区北10条西8丁目 北海道大学理学部植物学教室)