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***Ditrichum lineare* (Sw.) Lindb. with tubers in Asia**

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イトキンシゴケおよびその無性芽

Eleven species of *Ditrichum* have been previously reported in the moss flora of Japan. These include six endemic species (*D. dicranelloides* Sak., *D. kiusiense* Sak., *D. longipes* Sak., *D. macrorhynchum* Card., *D. mayebarae* Sak., and *D. subtortile* Card.), one Eurasian species (*D. astomoides* Limpr.), one East Asiatic species (*D. divaricatum* Mitt.), and three widespread species (*D. flexicaule* (Schwaegr.) Hampe, *D. heteromallum* (Hedw.) Britt., and *D. pallidum* (Hedw.) Hampe).

Field studies we have made have revealed the presence of *D. lineare* (Sw.) Lindb., a species not only new to Japan but also to the Asiatic region. In this paper we present a description and illustrations based on Japanese specimens, together with taxonomical notes and a first report and description of rhizoidal tubers for the species.

Specimens collected in Japan have so far only been found sterile. Plants (Figs. 1, 2) are characterized as follows: Stems 2-7 mm high, nearly triangular in section, with a narrow central strand of small thin-walled cells, epidermal layer of thick-walled cells; leaves 0.5-1.4 mm long, 0.15-0.35 mm wide, weakly appressed to the stem, imbricate and more or less triseriate, oblong-lanceolate, widest in or shortly below the middle, gradually narrowed towards the apex, subula short, channelled; leaf margins mostly bistratose, faintly and irregularly denticulate above, elsewhere unistratose and entire; lamina gently and widely recurved above; costa percurrent, wide, occupying about 1/3 of the width of the leaf at the base, with a weakly developed stereid band on the abaxial side of the guide cells; lamina cells with smooth, thin to moderately thickened walls, rectangular (usually 2-7:1), 6-8 μm wide at the leaf base, becoming slightly

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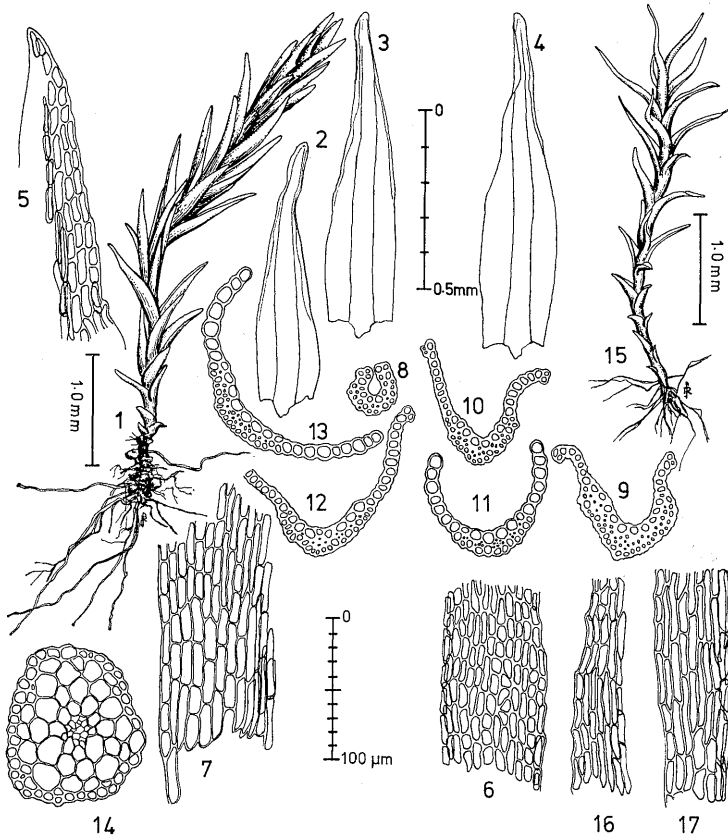


Fig. 1. *Ditrichum lineare* (Sw.) Lindb. 1. Whole plant. 2-4. Leaves from mid-stem. 5. Cells from upper margin of leaf. 6. Cells from mid-lamina. 7. Cells from leaf base. 8-13. Leaf sections. 14. Stem section. 15. Whole stem cultivated for four months in laboratory. 16. Marginal cells of mid to upper lamina from cultivated plant. 17. Cells of leaf base from cultivated stem. All derived from Deguchi 27604. Scales=1.0 mm for stems, =0.5 mm for leaves, =100 μ m for cells and sections.

shorter and narrower towards the leaf apex; rhizoids reddish-brown to light brown, with smooth walls; tubers (Figs. 2, 3) consisting of swollen rhizoidal cells arising laterally from axial rhizoids.

Japanese specimens examined: Honshu. Pref. Hyogo: Koyoen, Nishinomiya City, 190 m alt., on soil in open place, Aug. 15, 1984, leg. M. Sakamoto s.n., Matsui 660. Pref. Hiroshima: Miyajima Island (Shimomurohama), Saiki-gun,

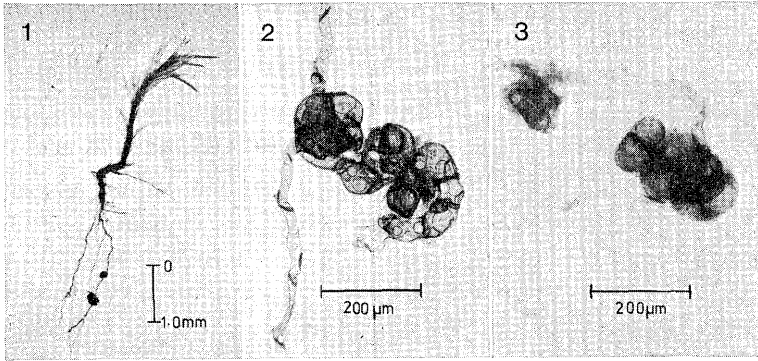


Fig. 2. *Ditrichum lineare*. Stem and tubers. 1. Stem with rhizoidal tubers in situ. 2, 3. Detail of rhizoidal tubers. 1 and 2 from Matsui 332, 3 from Deguchi 27604.

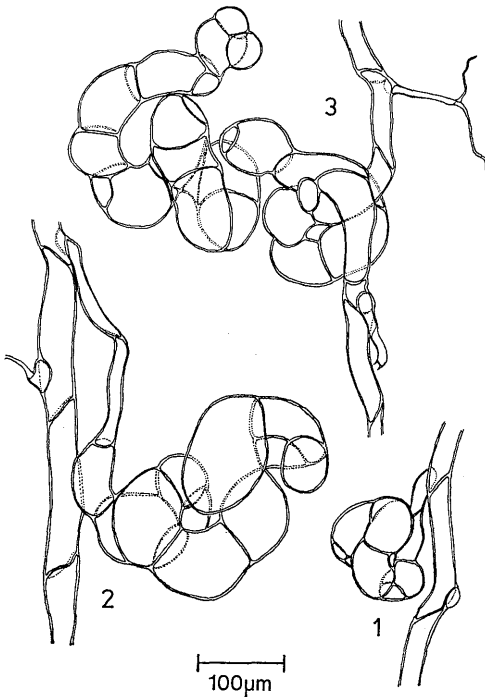


Fig. 3. *Ditrichum lineare*. Rhizoidal tubers. Drawn from Matsui 332.

10 m alt., on soil in open place, March 10, 1984, Deguchi 27604, 27605, Matsui 525. Shikoku. Pref. Ehime: Mt. Kamegamori, Saijo City, 1750 m alt., on soil at roadbank, Sept. 25, 1983, Deguchi 27144, do., Nov. 1, 1983, Matsui 332, 333. (All specimens cited above are preserved at the Herbarium of the Department of Biology, Kochi University).

Ditrichum lineare closely resembles *D. pusillum* (Hedw.) Hampe. *Ditrichum pusillum* is distinguishable from *D. lineare* by the recurved, irregularly thickened, serrulate leaf margins, short cells and erecto-patent, sometimes slightly secund, flexuose leaves (Fig. 5). Smith

(1978) considered *D. lineare* close to and easily confused with *D. cornubicum* Paton and *D. plumbicola* Crundwell. *Ditrichum plumbicola* has more shortly pointed leaves with plane margins, the stem is less triangular in section and the costa thinner and less prominent on the abaxial surface of the leaves, while *D. cornubicum* has leaves intermediate in shape between those of *D. lineare* and *D. plumbicola* and the leaves are erecto-patent to patent when moist, shorter, and the cells wider in the lower part of the lamina. *Ditrichum cornubicum* has multicellular rhizoidal gemmae. The relationship between *D. lineare* and *D. pusillum* is further discussed in Crum & Anderson (1981).

Smith (1978) observed that the leaf margins of European specimens of *D. lineare* were frequently narrowly recurved on one or both sides, entire or obscurely denticulate towards the apex. Crum & Anderson (1981) reported that the leaf margins in North American specimens were plane or rarely somewhat recurved in places and often bistratose. Our observations on Japanese specimens (Figs. 1, 4) agree with these findings. The subula is channelled and the lamina is gently and widely recurved. The margins are plane or narrowly recurved in places. This seems to be characteristic of *D. lineare* as being observed in Japanese, North American and European specimens.

Tubers or rhizoidal gemmae (Figs. 2, 3) have not been previously reported for *D. lineare*. Leaf morphology and the presence of tubers distinguish this species from *D. plumbicola*. We have observed a relatively frequent occurrence of tubers in specimens of *D. lineare* from Miyajima Island and much less frequently in specimens from Mt. Kamegamori. We have so far been unable to find tubers in European and North American specimens we have examined. The tubers of *D. lineare* are similar in morphology to those of *Ditrichum cylindricum* (Hedw.) Grout, *Dicranella varia* (Hedw.) Schimp., and *Dicranella subulata* (Hedw.) Schimp. (Whitehouse 1966). They are irregular in shape and usually have the form of a curved or twisted line of swollen cells, becoming somewhat coiled when well developed and thus appearing rather globular. The walls of the tubers are smooth and of a similar thickness to the normal rhizoidal cells.

Although the leaves of *D. lineare* are imbricate and weakly appressed to the stem when dry as well as when moist, new shoots derived from Japanese plants (Deguchi 27604) cultivated in a humid condition in plastic chambers at 10–15°C for four months (April to July 1984) gave rise to leaves of different morphology from that of the parental plants (Fig. 1.15–17). Leaves from the

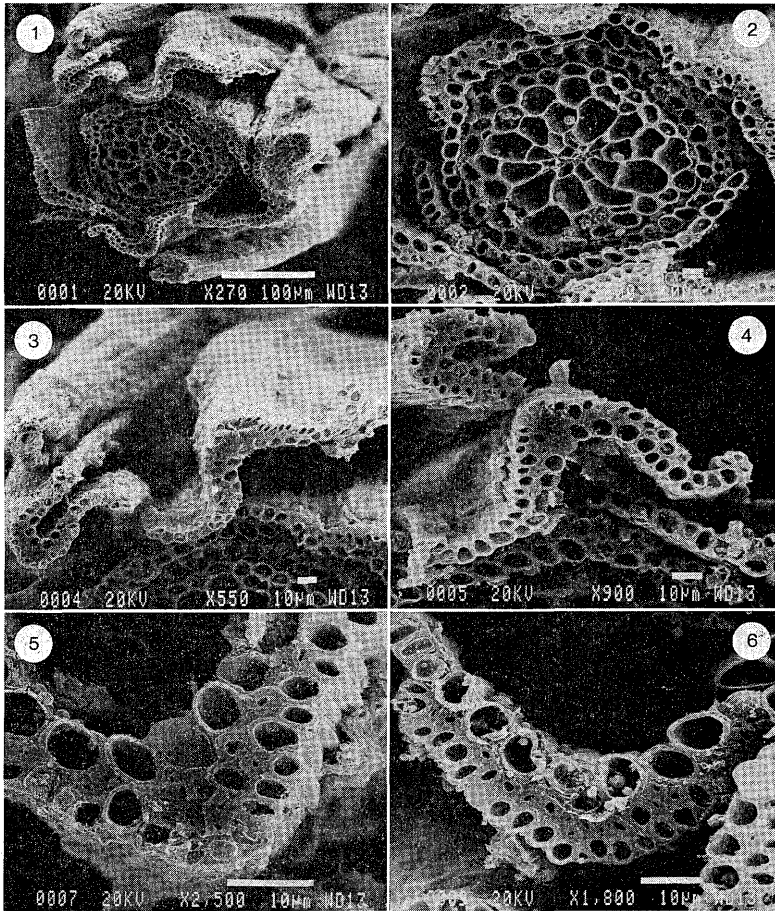


Fig. 4. *Ditrichum lineare*. Scanning electron micrographs. 1. Section of upper part of shoot showing deeply channelled subula and bistratose and unistratose leaf margins. 2. Stem section. 3, 4. Leaf sections showing detail of subula and bistratose leaf margin. 5. Mid-lamina section showing detail of costa with groups of thick-walled stereid cells. 6. Costal section from lower mid-lamina showing uniform layer of thick-walled stereids. All from Deguchi 27604. Bar scales=100 μm for 1, =10 μm for 2-6.

basal part of the new shoots are comparable to those of the parent plant but the upper leaves have an acute apex, are erect-spreading and reach to 1.25 mm long and 0.12 mm wide. Modification of environmental factors may have a marked effect on morphology of cultured mosses with important taxonomic

implications (Seppelt & Selkirk 1984) and further experiments are necessary to determine whether all populations exhibit such variation on morphology.

Ditrichum lineare is widely distributed in central and northern Europe from lowland to alpine localities (Nyholm 1954; Frahm & Frey 1983), scattered in Britain (Smith 1978), and in eastern North America (Crum 1976; Ireland et al. 1980; Crum & Anderson 1981; Ireland 1982). The Japanese specimens were collected at two different vegetation zones: hilly zone

(5 m above sea level on Miyajima Island, Hiroshima Pref. and 190 m in Nishinomiya City, Hyogo Pref.) and subalpine zone (1750 m on Mt. Kamegamori, Ehime Pref.). The materials of the Miyajima Island and Nishinomiya were growing on silty soil in open places surrounded by *Pinus densiflora* forests, where the bryophyte flora is poorly represented. On Mt. Kamegamori the specimens were collected on humic soil in open places where *Sasa palmata* var. *niijimae* dominates, associated with *Oligotrichum aligerum*, a western North American element and a rather common species in subalpine regions in Japan. These two Japanese localities of considerably different climatic conditions seem to suggest that the species might be widely distributed in central and northern Japan.

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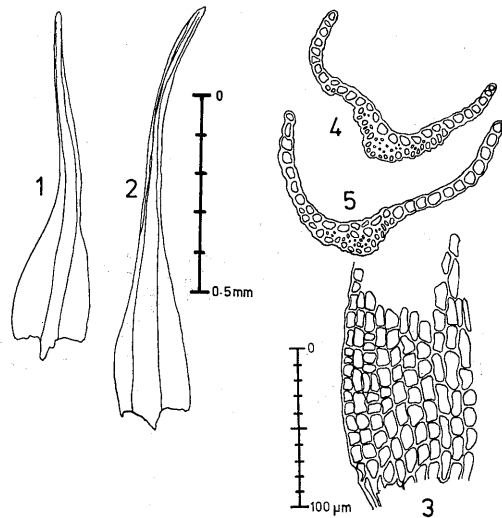


Fig. 5. *Ditrichum pusillum* (Hedw.) Hampe. 1, 2. Mid-stem leaves. 3. Cells from leaf base. 4, 5. Sections from mid-lamina region of leaf. From Alvarez & Saprid 0-78442, Mt. Pulog, Bengual Province, Luzon, Philippines. Scales=0.5 mm for lerves, =100 μ m for cells and sections.

comments on the manuscript. We thank Ms. Geraldine Nash, Antarctic Division, for scanning electron microscopy, and Mr. M. Sakamoto for sending specimens.

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最近、アジアでは未知であったイトキンシゴケ（新称）の生育を兵庫県および広島県、愛媛県で確認した。イトキンシゴケは外見上 *Ditrichum pusillum* (Hedw.) Hampe, *D. cornubicum* Paton, *D. plumbicola* Crundw. (いずれも日本からは知られていない) と非常によく似ている。このうち *D. plumbicola* は葉形、特に平坦な葉縁と薄い中肋を持つこと等によりイトキンシゴケと区別される。*D. pusillum* と *D. cornubicum* は葉形、葉の並び方とともに仮根に無性芽 (tuber) を付けることでイトキンシゴケと区別されてきたが、イトキンシゴケにも仮根に無性芽が発見された。この無性芽は1列の細胞群がコイル状にねじれ、外見上球形に見える。これは *D. pusillum* や *D. cornubicum* で見られるような多くの細胞があつまり球形をなしているものとは形態が全く異なったものである。今回イトキンシゴケが丘陵帯（兵庫県西宮市海拔 190 m および広島県宮島町 5 m）および亜高山帯（愛媛県西条市瓶ヶ森 1750 m）というかなり隔りのある植生帯域から発見されたことと、既報の外国での生育地から判断して、我国にも本種がかなり広く分布していることが考えられる。