

A Taxonomic Study on the Lichen Genus *Staurothele* (Verrucariaceae) in Japan*

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Abstract The lichen genus *Staurothele* (Verrucariaceae) in Japan is taxonomically revised. Two species are recognized: *S. iwatsukii* Harada sp. nov. and *S. japonica* B. de Lesd. Detailed descriptions and illustrations, as well as notes on habitat, range and taxonomy are provided. A list of specimens examined and a key to the species are also given.

Key words: Lichenes, taxonomy, Verrucariaceae, *Staurothele*.

Within the family Verrucariaceae, the genus *Staurothele* is characterized by having hymenial algae, muriform spores and crustose thallus. In Japan, only one species of this genus has been previously reported: *S. japonica* B. de Lesd. from Kamui-kotan in Hokkaido by Bouly de Lesdain (1921).

In the present study, the genus *Staurothele* in Japan is taxonomically revised, and two species are recognized.

Staurothele Norm.

Staurothele, Norm., Nyt Mag. Naturv. 7: 240 (1853). Type species: *Staurothele clopima* (Wahlb.) Th. Fr.

Description. Thallus crustose. Perithecia immersed in the thallus or partly exposed, with involucrellum, with hymenial algae; asci bitunicate; spores 8 in each ascus (sometimes less in number), muriform, more or less brown to almost hyaline. Pycnidia immersed in thallus, of the *Staurothele*-type.

Key to the species of *Staurothele*

- 1a. Thallus rimulose; hymenial algae oblong to bacilliform; spores 6-8 in each ascus.....*S. iwatsukii*
- 1b. Thallus areolate; hymenial algae spheric; spores 8 in each ascus.....*S. japonica*

1) *Staurothele iwatsukii* Harada, sp. nov.

(Figs. 1A & B, 2)

Affinis S. japonicae sed differt thallo rimuloso, algis hymeniae elongatis.

Typus: Japan, Shikoku, Kôchi-ken, Takaokagun, Yusuhara-chô, Jôsei, 450 m alt., on rock at the edge of stream, 2 Aug. 1985, H. Harada 3401 (HIRO - *holotypus*; NMW, CBM - *isotypi*).

External Morphology. Thallus crustose, epilithic, uniform, rimulose, irregularly cracked, dark to somewhat pale brown, dull or a little glossy, smooth, epruinose. Perithecia common, abundant, scattered over thallus, usually single in each areole, immersed in the thallus, slightly raised and very dark brown to almost black around ostioles (0.1-0.5 mm across). Pycnidia not common, immersed in thallus, indistinct, brown in diam. of ca. 0.05 mm around ostioles (circular or somewhat irregular in shape).

Anatomy. Thallus 110-480 μ m thick. Upper cortex up to 20 μ m thick, weakly differentiated from medulla, euparaplectenchymatous, more or less brownish in the uppermost, hyaline in the remainder; lumina of hyphae 2.5-4 μ m across; walls of hyphae ca. 1 μ m thick. Medulla (20-)40-170 μ m thick, subpara-to euparaplectenchymatous; lumina of hyphae 2.5-4(-5) μ m long, 2-3 μ m wide; walls of hyphae 0.5-1 μ m thick; phycobiont cells more or less evenly distributed in medulla, more or less in vertical rows. The basal layer 90-250 μ m thick, subpara-to euparaplectenchymatous, sometimes prosoplectenchymatous, very dark brown to almost black in the uppermost parts, more or less brown in the remainder, paler

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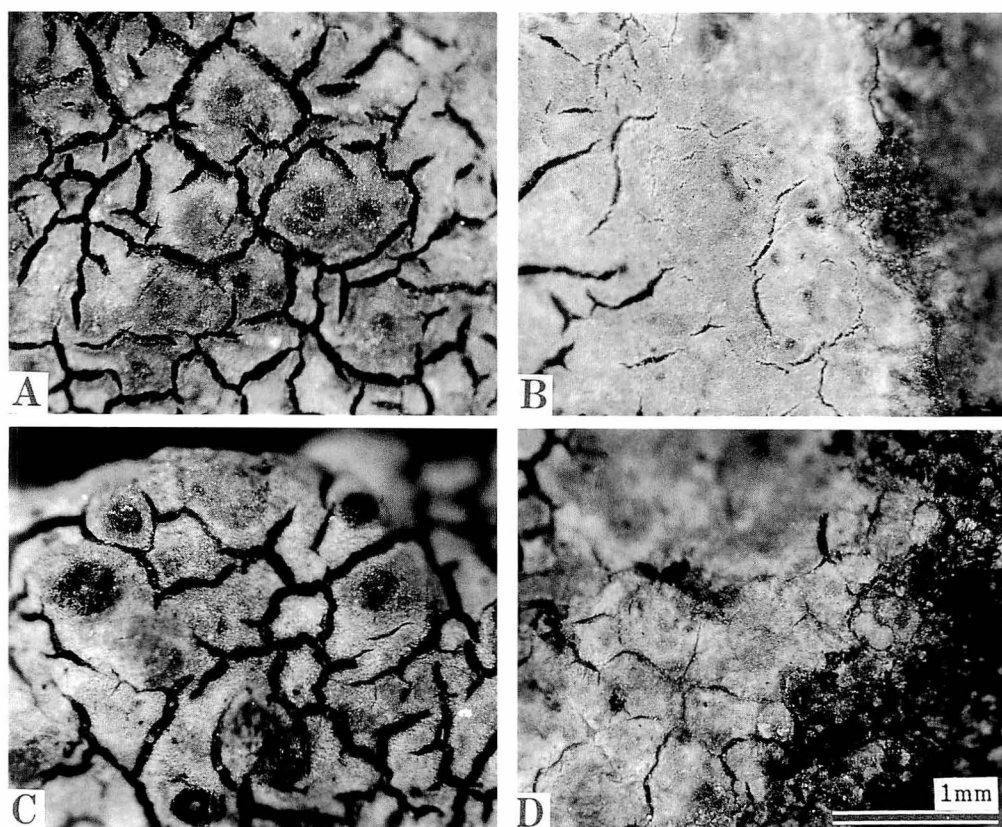


Fig. 1. Habit of *Staurothele*. A-B, *S. iwatsukii* (holotype); C-D, *S. japonica* (lectotype). A, C, central part of thallus; B, D, marginal part of thallus.

in the lower, tightly attaching to the substrata; lumina of hyphae 3–5 μm across in the upper ones, ca. 2 μm wide and 2–4 μm long in the lower ones (variously oriented); walls of hyphae thin, 0.5–1 μm thick. Perithecia pyriform to almost spheric, 180–410 μm high, 170–300 μm wide; involucrellum merging with the basal layer of thallus; exciple almost hyaline or more or less brown, 5–20 μm thick in the side and bottom, thicker at the uppermost (up to 120 μm thick); subhymenium 10–20 μm thick; periphyses 30–40 μm long; hymenium 200–370 μm high, 120–250 μm wide; hymenial algae oblong to bacilliform, or almost spheric, (2–) 5–7(–9) μm long, ca. 2 μm wide; asci clavate, 45–75 μm long, 15–20 μm wide; spores 6–8 in an ascus, hyaline to very pale brown or yellowish, muriform, with 4–7 transverse septa and 1–2 longitudinal septa, ellipsoidal (somewhat broad), 20–33 \times 8–12 μm . Pycnidia of the *Staurothele*-type, pyriform to almost spheric; pycnoconidia bacilliform, 3–5 \times ca. 1 μm .

Habitat. On rocks at the edge of streams.

This lichen is widely distributed in Japan and seems to be somewhat common on riverside rocks on the upper and middle region of rivers where clear water flows. I have found the lichen on rocks, submerged in water or exposed, only at the edge of streams. This species occurs usually side by side with other members of Verrucariaceae: *Dermatocarpon miniatum*, *Endocarpon* sp., and/or *Verrucaria* spp.

Range. Endemic to Japan.

Specimens examined. HONSHU. Gifu-ken: Mino-shi, 70 m alt., H. Harada 3530 (HIRO). Hiroshima-ken: Saiki-gun, Yoshiwa-mura, Mt. Kanmuri, 600–700 m alt., H. Harada 2711 & 3227 (HIRO). SHIKOKU. Kôchi-ken: Agawa-gun, Agawa-mura, 100 m alt., H. Harada 3319 (HIRO); Takaoka-gun, Yusu-hara-chô, 450 m alt., H. Harada 3395 & 3403 (HIRO), 3401 (HIRO - holotype; CBM & NMW - isotypes); Ônomi-mura, 300 m alt., H. Harada 3436 (HIRO).

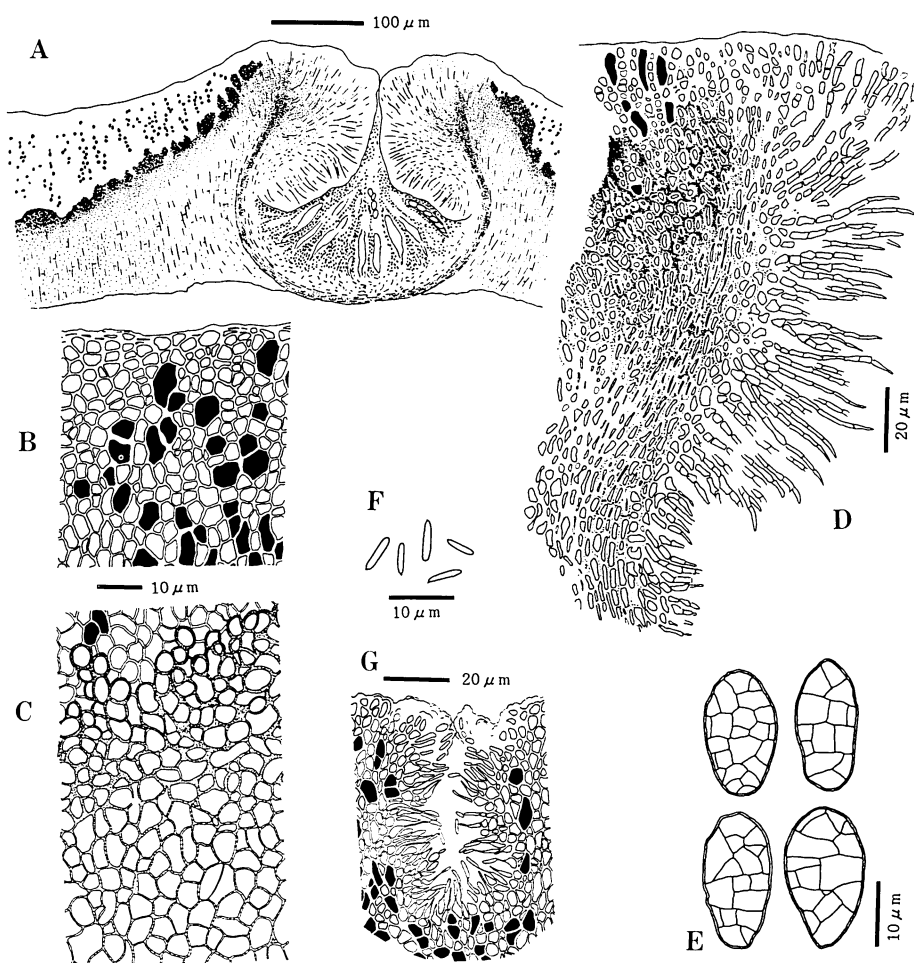


Fig. 2. *Staurothele iwatsukii* Harada. A, vertical section of perithecium. B, upper part of thallus in vertical section. C, lower part of thallus in vertical section. E, spores. F, pycnoconidia. G, vertical section of pycnidium. A-C, E, GAW preparations; D, F, G, LPCB preparations. A-D, F, G, holotype; E, Harada 3319.

Remarks. This species resembles *Staurothele japonica*, particularly in the central part of the thallus where the thalli are areolate in both species. However, these two species apparently differ from each other in the marginal part of thallus, with a rimulose form in *S. iwatsukii* and an areolate one in *S. japonica*. They also have different types of hymenial algae, being oblong to bacilliform in the former species and spheric in the latter.

In having a rimulose thallus, the present species resembles *Staurothele fauriei*, another East Asian species of the genus described by Bouly de Lesdain (1921) on the basis of one specimen among the Faurie collection of lichens from Taiwan. Although no specimen of *S. fauriei* has been

available for this study, the present species is distinguishable from it in morphology when compared with the original description. According to Bouly de Lesdain (1921), *S. fauriei* has thin thallus and the ascomata are first immersed in the thallus and become more or less exposed later (as "Thallus ... tenuis,... Apothecia ... primum immersa, dein plus minusve emersa ..."). Thallus of *S. iwatsukii* is on the other hand, rather thick and the ascomata are usually immersed in the thallus. Each ascus contains 8 hyaline spores in *S. fauriei* (Bouly de Lesdain 1921) but 6 to 8 spores of hyaline to pale brown color in *S. iwatsukii*.

2) *Staurothele japonica* B. de Lesd.

(Fig. 1C & D)

Staurothele japonica B. de Lesd., Bull. Soc. Bot. Fr. 68 : 492 (1921); Harada and Iwatsuki, J. Jap. Bot. 64 : 33-36, fig. 1 (1989). Type : Japan, Hokkaido, Kamuikotan, on rock, September 1904, U. Faurie 6213 (KYO - lectotype & isotype).

External Morphology. Thallus crustose, epilithic, areolate, pale to somewhat dark brown, partly yellowish, dull or a little glossy, smooth, epuriose. Areoles more or less discrete near the margin of the thallus. Perithecia common, usually solitary but sometimes two in each areole, immersed in the thallus, dark brown to blackish around ostioles (0.1-0.5 mm across). Pycnidia not found.

Anatomy. Thallus 100-430 μm thick. Upper cortex up to 30 μm thick, weakly differentiated from medulla, sometimes brownish at the uppermost, hyaline in the remainder, usually with hyaline epinecral layer (ca. 10 μm thick); lumina of hyphae 2.5-4 μm across; walls of hyphae ca. 1 μm thick. Medulla 20-130 μm thick, eupara- to subparaplectenchymatous; lumina of hyphae 2-4(-6) μm high, 2.5-4 μm wide, arranged more or less in vertical rows; walls of hyphae 0.5-1 μm thick; phycobiont cells almost evenly distributed in medulla, in small clusters. Basal layer largely variable in thickness, 40-280 μm thick, very dark brown to blackish in the uppermost part, brown in the remainder, subpara- to euparaplectenchymatous; lumina of hyphae 5-8(-10) μm high, 3-5(-8) μm wide; walls of hyphae usually 0.5-1 μm thick. Perithecia pyriform to almost spheric, 290-310 μm high, 220-280 μm wide; involucrellum merging with the basal layer of thallus; exciple prominent almost hyaline or more or less brown, up to 60 μm thick; subhymenium 10-20(-50) μm thick; periphyses 30-40 μm long; hymenium 220-230 μm high, 190-330 μm wide; hymenial algae almost spheric, 2-3 μm across; asci clavate, 60-90 μm long, 15-25 μm wide; spores 8 in an ascus, hyaline to very pale brown, muriform, with 3-10 transverse and 1-3 longitudinal septa, ellipsoidal, 21-27 \times 8-11 μm .

Habitat. On rocks.

A knowledge of the habitat of this species is only available from the protologue and the type specimens in the herbarium of Kyoto University (KYO). The protologue says "sur une roche siliceuse" which well coincides with the type. Any

other information on the habit can not be obtained from the labels.

Range. Endemic to Japan.

Specimens examined. HOKKAIDO. Kamuikotan, U. Faurie 6213 (KYO - lectotype & isotype).

Remarks. Since this species was described by Bouly de Lesdain (1921) on the basis of one specimen from Hokkaido collected by U. Faurie in 1903, it had been neglected by lichenologists until recently when the lectotypification was made (Harada & Iwatsuki 1989). In 1987 I made a collection trip to Kamuikotan, the type locality, and adjacent areas; however, *Staurothele japonica* was not found. The type is still the only known specimen of this species.

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日本産ミドリサネゴケ属 (アナイボゴケ科) 地衣類の分類学的研究

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日本産ミドリサネゴケ属 (新称) (*Staurothele*) 地衣類の分類学的検討を行った。従来から報告のあったエゾノミドリサネゴケ (*S. japonica* B. de Lesd.) に加え、ミドリサネゴケ (*S. iwatsukii* Harada sp. nov.) を新種として記載し、合計 2 種を認めた。両種について記載と地衣体の写真を示し、更に新種については詳細な解剖図を加え、また日本産ミドリサネゴケ属の検索表を掲げた。