Notes on *Fissidens* (Fissidentaceae, Bryopsida) in Japan

Tadashi Suzuki

1The Hattori Botanical Laboratory, Shimada Branch, 6480-3 Takasago-cho, Shimada-shi, Shizuoka-ken 427-0054, Japan

Abstract. Ten species are added to the *Fissidens* flora of Japan. *Fissidens kiguchii* and *F. takayukii* are new to science. Eight species of *Fissidens*, namely *F. crispus*, *F. excurrentinervis*, *F. perssonii*, *F. platyphyllus*, *F. pseudoceylonensis*, *F. sublineaefolius*, *F. taylorii*, and *F. ventricosus* are additions to the moss flora of Japan. *Fissidens platyphyllus* Broth., previously considered a synonym of *F. amoenus* Müll. Hal. is recognized as a good species. *Fissidens microcladus* Thwait. & Mitt. is proposed as a new synonym of *F. pallidinervis* Mitt. *Fissidens boninensis* newly found in Ibaraki-ken, Honshu, Japan.

Introduction

Suzuki and Iwatsuki (2012) added 27 species to the Japanese *Fissidens* flora. Later, Suzuki and Iwatsuki (2013) added six species to the Japanese *Fissidens* flora, bringing the total number to 80 species and 5 varieties. In this paper, I add ten species, two species are new to science, and eight species are new to the Japanese flora. All collections are deposited in the Herbarium of the Hattori Botanical Laboratory (NICH). Types of costae in cross section and peristomes given in descriptions were described in Suzuki & Iwatsuki (2007). Descriptions, specimens examined, distributions, notes, keys to the species, and illustrations of 11 species are included.

**Ia. Fissidens subgen. Fissidens sect. Fissidens**


Plants light green to dark green, hygrophilous. Stems simple, 4.8–7.8 mm long, 2.0–2.5 mm wide with leaves; axillary hyaline nodules not differentiated; cortical cells in cross section small and thick walled; central strand slightly differentiated. Leaves in 8–10 pairs, upper leaves oblong lanceolate, 1.5–1.8 mm long, 0.4–0.5 mm wide, acute; base of dorsal lamina wedge shaped, not decurrent; costa excurrent, *Bryoides*-type in cross section; margin weakly serrulate near apex; vaginant laminae 1/2–3/5 of leaf length; limbidium stout, usually turning yellowish brown on older leaves when treated with KOH, usually confluent with costa at apex, 2–3 rows of elongate cells on dorsal laminae, 4–6 rows of elongate cells of vaginant laminae, 1–3 cells thick; laminae unistratose, cells of apical lamina irregularly quadrate to
hexagonal, 9.0—12.5 \( \mu m \) long, smooth, more or less weakly mammilllose, thin walled.

Gonioautoicous; perigonia in leaf axils of stem; setae terminal, 1.6—2.5 mm long; capsules erect and symmetrical; urn 0.8—0.9 mm long; exothecial cells rounded quadrate, 16—18 \( \mu m \) long; opercula rostrate, 0.4—0.5 mm long; peristome teeth 258—305 \( \mu m \) long, 38—43 \( \mu m \) wide at base, \textit{Fissidens}-type; spores 12—17 \( \mu m \) in diam., smooth; calyptrae cucullate, about 0.7 mm long.


Specimens examined. Honshu, Tochigi-ken, Nikko-shi, Hiragasaki, 400 m alt., on soil by stream, Kamiyama 7538, 7584, 7586, 7588.

Distribution: North America, Mexico, Central America, West Indies and South America; \textbf{new to Japan} (Honshu).

2. \textit{Fissidens excurrentinervis} R. S. Williams, Bull. New York Bot. Gard. 3(9): 112 (1903). Fig. 2.

Plants dull green. Fertile and sterile stems dimorphic, fertile stems usually shorter, 1.2—2.6 mm long, 0.6—1.2 mm wide with 2—3 pairs of leaves; sterile stems 2.5—5.0 mm long, 1.2—2.7 mm wide with 4—6 pairs of leaves; axillary hyaline nodules not differentiated; cortical cells in cross section small and thick walled, central strand weakly differentiated. Upper leaves narrowly lanceolate, 0.5—1.0 mm long, 0.1—0.2 mm wide, narrowly acute; base of dorsal lamina wedge shaped, not decurrent; costa subpercurrent, \textit{Bryoides}-type in cross section; margin weakly serrulate near apex; vaginant laminae 1/2—3/5 of leaf length; limbidium usually colorless, ending below apex, 1—2 rows of elongate cells on dorsal laminae, 2—4 rows of elongate cells on vaginant laminae, 1 cell thick; laminae unistratose, cells of apical lamina irregularly quadrate to hexagonal, 7.5—13.0 \( \mu m \) long, smooth, thin walled.

Rhizoautoicous; perigonia at base of stem; setae terminal, 1.4—3.1 mm long; capsules erect and symmetrical; urn about 0.7 mm long; exothecial cells rounded quadrate to rounded rectangular, 12.5—25.0 \( \mu m \) long, 7.5—12.5 \( \mu m \) wide; peristome teeth irregularly divided, 100—215 \( \mu m \) long, 25—35 \( \mu m \) wide at base, \textit{Fissidens}-type; spores 9.0—17.5 \( \mu m \) in diam., smooth.

Additional descriptions: Sharp et al. 1994, 64, f. 45; Pursell 2007, 109, f. 54.

Specimens examined. Honshu, Tochigi-ken, Nikko-shi, Zenbo, Ohzasa-zawa, 470 m alt., on clay soil by stream, Kamiyama 10069, 10095, 10097. Kuragasaki, 340 m alt., on soil bank by river, Kamiyama 10297.

Distribution: Mexico, Central America, West Indies and South America; \textbf{new to Japan} (Honshu).

3. \textit{Fissidens perssonii} P. de la Varde in Perss., Bot. Not. 1939: 572.2 (1939). Fig. 3.

Plants dull green, hydrophilous. Stems unbranched to profusely branched, 0.6—1.3 cm long, 2.4—4.0 mm wide with leaves; axillary hyaline nodules not differentiated; cortical cells in cross section small and thick walled; central strand differentiated. Leaves in 5—14 pairs, upper leaves elliptical, 2.1—2.6 mm long, 0.4—0.6 mm wide, acute; base of dorsal lamina wedge shaped, decurrent; costa excurrent, \textit{Bryoides}-type in cross section; margin entire throughout; vaginant laminae about 3/5 of leaf length; limbidium stout, usually turning yellowish brown on older leaves when treated with KOH, usually confluent with costa at apex,

Plants yellowish green, hydrophilous. Stems simple or branched, 7.5–12.5 mm long, 2.2–3.3 mm wide with leaves; axillary hyaline nodules not differentiated; cortical cells in cross section small and thick walled; central strand slightly differentiated. Leaves in 11–14 pairs, upper leaves narrowly lanceolate, 2.4–3.1 mm long, 0.4–0.5 mm wide, widely acute; base of dorsal lamina wedge shaped, decurrent; costa ceasing below apex, Bryoides-type in cross section; margin entire throughout; vaginant laminae about 3/5 of leaf length; limbidium stout, usually turning yellowish brown on older leaves when treated with KOH, ending below apex, 5–7 rows of elongate cells on dorsal laminae, 3–4 rows of elongate cells of vaginant laminae, 2–4 cells thick; laminae unistratose, cells of apical lamina irregularly quadrate to hexagonal, 7.5–15.0 \( \mu \)m long, smooth, thin walled.

Synoicous; synoecia terminal; setae terminal, 4.0–5.3 mm long; capsules erect and symmetrical; urn 0.8–1.0 mm long; exothecial cells rounded quadrate to rounded rectangular, 20.0–32.5 \( \mu \)m long, 15.0–22.5 \( \mu \)m wide; opercula rostrate, about 0.5 mm long; peristome teeth irregularly divided, 250–295 \( \mu \)m long, 40–45 \( \mu \)m wide at base, Fissidens-type; spores 15–20 \( \mu \)m in diam., smooth.


Specimens examined. Honshu, Tochigi-ken, Nikko-shi, Sannai, 670 m alt., on soil submerged in stream, Kamiyama 9323, 9324, 9325, 9449, 9451, 9770.

Distribution: Europe; new to Japan (Honshu).

5. Fissidens taylorii Müll. Hal., Syn. Musc. Frond. 1: 65 (1849) [1848]. Fig. 5.

Plants yellowish green. Fertile and sterile stems dimorphic, fertile stems 1.6–2.3 mm long, 0.8–1.0 mm wide with 4–6 pairs of leaves; sterile stems 1.5–2.4 mm long, 0.8–1.3 mm wide with 4–9 pairs of leaves; axillary hyaline nodules not differentiated; cortical cells in cross section small and thick walled, central strand not differentiated. Upper leaves lanceolate, 0.6–0.9 mm long, 0.2–0.3 mm wide, acute; base of dorsal lamina wedge shaped, not decurrent; costa ceasing below apex, Bryoides-type in cross section; margin entire throughout; vaginant laminae about 3/5 of leaf length; limbidium usually colorless, ending below apex, 1 row elongate cells on dorsal laminae, 2–3 rows of elongate cells on vaginant
laminae, 1 cell thick; laminae unistratose, cells of apical lamina irregularly quadrate to hexagonal, 6.3–12.5 μm long, smooth, thin walled.

Rhizoautoicous; perigonia at base of stem; setae terminal, 0.9–1.3 mm long; capsules erect and symmetrical; urn 0.3–0.4 mm long; exothecial cells rounded rectangular, 17.5–30.0 μm long, 7.5–17.5 μm wide; opercula conical-rostellate, 0.2–0.3 mm long; peristome teeth 100–180 μm long, 25–35 μm wide at base, Fissidens-type; spores 12.5–15.0 μm in diam., smooth; calyptrae cucullate, 0.4–0.5 mm long, smooth.


Specimens examined. Honshu, Tochigi-ken, Nikko-shi, Kuragasaki, 340 m alt., on rock by stream, Kamiyama 9987, 10135, 10137, 10143, 10145.

Distribution: North America, Mexico, West Indies, South America, Australia and New Zealand; new to Japan (Honshu).

6. **Fissidens ventricosus** Lesq., Mem. California Ac. Sc. 1: 7 (1868). Fig. 6.

Plants yellowish green to dark green, hydrophilous. Stems simple or branched, 0.7–1.2 cm long, 3.0–3.5 mm wide with leaves; axillary hyaline nodules not differentiated; cortical cells in cross section small and thick walled; central strand not differentiated. Leaves in 7–12 pairs, upper leaves oblong lanceolate, 2.3–2.7 mm long, about 0.6 mm wide, acute to apiculate; base of dorsal lamina wedge shaped, slightly decurrent; costa ending just below apex, Bryoides-type in cross section; margin entire throughout; vaginant laminae about 3/5 of leaf length; limbidium stout, usually turning yellowish brown on older leaves when treated with KOH, ending below apex, 4–5 rows of elongate cells on dorsal laminae, 6–8 rows of elongate cells of vaginant laminae, 3–6 cells thick; laminae unistratose or with bistratose regions; cells of apical lamina irregularly quadrate to hexagonal, 8–11 μm long, smooth, moderately thick walled.

Synoicous; sporophytes 1–2 per synoecium; setae terminal, 4.5–5.5 mm long; capsules slightly asymmetrical; urn about 1.0 mm long; exothecial cells rounded quadrate to rounded rectangular, thin walled with distinctly thickened corners, 15–25 μm long, 12.5–20.0 μm wide; opercula rostrate, about 0.4 mm long; peristome teeth irregularly divided, 225–300 μm long, 35–45 μm wide at base, Fissidens-type; spores 22.5–27.5 μm in diam., smooth; calyptrae cucullate, about 0.7 mm long, smooth.


Specimens examined. Honshu, Tochigi-ken, Nikko-shi, Zenbo, Ohzasa-zawa, 470 m alt., on rock submerged in stream, Kamiyama 10055, Kuragasaki, 365 m alt., on rock submerged in stream, Kamiyama 10517.

Distribution: North America; new to Japan (Honshu).

**Key to the species of subgen. Fissidens sect. Fissidens in Japan**

1. Leaves soft and flaccid; areolation of apical lamina lax, cells large, elongate 16–45–(54) μm long, thin walled .......................................................................................................................................................... 2
1. Leaves firm; cells of apical lamina dense, isodiametric, usually less than 15 μm long, rarely more than 20 μm long, if more than 20 μm long, then vaginant lamina unequal at upper end ............... 3
2. Leaves imbricate to the base of stem; leaf margins elimbate or weakly limbate with 1—2 rows of elongate cells (often intralaminal); limbidia always unistratose; plants rhizoautoicous …………………… F. bogoriensis

2. Leaves distant; leaf margins with distinct limbidia on all laminae, composed of linear, thick walled cells, limbidia 2—3 cells thick; plants dioicous …………………… F. flaccidus

3. Limbidia usually stout and distinct on apical laminae, yellowish brown or reddish on older leaves when treated with KOH ………… 4

3. Limbidia weak to distinct, usually colorless ………… 7

4. Setae lateral or terminal ………… 5

4. Setae always terminal ………… 7

5. Plants aquatic ………… F. perssonii

5. Plants not aquatic ………… 8

6. Leaves oblong lanceolate, costae excurrent ………… F. coacervatus

6. Leaves elliptical, costae percurrent ………… F. inconstans

7. Leaves elliptical ………… F. ovatifolius

7. Leaves not as above ………… 8

8. Plants autoicous ………… 9

8. Plants synoicous ………… 10

9. Small plants, stems 1.8—3.0 mm long including leaves; plants rhizoautoicous ………… F. gracilifolius

9. Medium sized plants, stems 4.8—11.0 mm long including leaves; plants gonioautoicous ………… 10

10. Stems 7.5—11.0 mm long including leaves; capsules usually horizontal, more or less asymmetrical ………… F. curnovii

10. Stems 4.8—7.8 mm long including leaves; capsules straight and symmetrical ………… F. crispus

11. Cells of apical laminae small, 5—9 μm long and mammillose ………… F. kimurae

11. Cells of apical laminae large, 7—20 μm long and smooth, but occasionally more or less mammillose ………… 12

12. Costa excurrent, limbidia usually confluent with costae at apex ………… F. rivularis

12. Costa percurrent or ceasing below apex, limbidia usually ending below apex ………… 13

13. Costa ceasing below apex ………… 14

13. Costa percurrent ………… 15

14. Leaf apices narrowly acute, base of dorsal lamina often more or less decurrent ………… F. pusillus

14. Leaf apices widely acute, base of dorsal lamina decurrent ………… F. sublineaeafolius

15. Laminae unistratose or with bistratose regions ………… F. ventricosus

15. Laminae always unistratose ………… 16

16. Leaf apices obtuse ………… F. rufulus

16. Leaf apices acute ………… 17

17. Cells of apical laminae 5—13 μm long ………… F. geppii

17. Cells of apical laminae 13—20 μm long ………… F. crassipes

18. Capsules straight to inclined, symmetrical or slightly asymmetrical ………… 19

18. Capsules curved, asymmetrical ………… 33

19. Perichaetia and setae lateral or terminal; leaves of lateral perichaetia much smaller than stem leaves ………… 20

19. Perichaetia and setae always terminal; perichaetal leaves as large as, or much larger than stem
20. Setae longer, 5.0—11.0 mm long ................................................. \textit{F. longisetus}
20. Setae shorter, less than 3.5 mm long ........................................ 21
21. Leaves imbricate, oblong ovate to oblong lanceolate; leaf apices obtuse and mucronate .......... 21
21. Leaves distant, lanceolate to linear lanceolate; leaf apices acute ................................. \textit{F. bryoides} var. \textit{lateralis}
22. Cells of apical laminae large, 7—22 μm long, and smooth, but occasionally more or less mammillose ........................................ 23
22. Cells of apical laminae small, 4—10 μm long, and mammillose ................................. \textit{F. schmidii}
23. Cells at base of vaginant laminae much larger, to 52 μm long, than those of apical laminae 12—22 μm long; axillary hyaline nodules distinct ........................................ 24
23. Cells at base of vaginant laminae slightly larger, to 27 μm long, than those of apical laminae, 7—14—(17) μm long; axillary hyaline nodules weakly or not differentiated ................. 24
24. Stems dimorphic; perichaetial leaves much larger than lower leaves ........................... 25
24. Stems monomorphic; perichaetial leaves not well differentiated .................................. 30
25. Limbidia conspicuously intralaminal in proximal parts of vaginant laminae of perichaetial leaves .... \textit{F. arcticus}
25. Limbidia not intralaminal in vaginant laminae of perichaetial leaves .............................. 25
26. Peristome teeth irregularly divided ............................................................................. \textit{F. excurrentinervis}
26. Peristome teeth regularly divided .............................................................................. 27
27. Leaves ovate to oblong lanceolate; spores 22—32 μm in diam. ................................. \textit{F. diversifolius}
27. Leaves lanceolate to linear lanceolate; spores 12—22 μm in diam. ............................. 28
28. Limbidia weak to almost lacking on sterile stems ........................................................ \textit{F. bryoides} var. \textit{esquirolii}
28. Limbidia distinct on sterile stems ............................................................................. 29
29. Leaves linear lanceolate, narrowly acute ...................................................................... \textit{F. curvatus}
29. Leaves lanceolate, acute ............................................................................................. \textit{F. taylorii}
30. Leaves broadly lanceolate; limbidia intralaminal in proximal parts of vaginant laminae of perichaetial leaves ................................................................. \textit{F. sublimbatus}
30. Leaves lanceolate to oblong lanceolate or lanceolate to linear lanceolate, limbidia not as above .............................................................................................................. 31
31. Leaf apices obtuse and mucronate; peristome teeth 250—310 μm long ......................... \textit{F. viridulus}
31. Leaf apices acute; peristome teeth less than 250 μm long ................................................ 32
32. Plants gonioautoicous, perigonia bud-like (rarely naked) in axils of stem leaves; central strand weakly differentiated ................................................................. \textit{F. bryoides} var. \textit{bryoides}
32. Plants synoicous (often polyoicous), antheridia mixed with archegonia and terminal on stems or branches, but often bud-like in leaf axils (rarely at base of branches), sometimes more than two perichaetial branches and a few perigonia in the same leaf axils; central strand lacking ................................................................. \textit{F. bryoides} var. \textit{ramosissimus}
33. Cells of apical laminae 16—25—(30) μm long; upper end of vaginant laminae usually quite unequal ................................................................. \textit{F. beckettii}
33. Cells of apical laminae 7—14 μm long; vaginant laminae equal to slightly unequal ............. 34
34. Leaves lanceolate to oblong lanceolate, rarely narrowly ovate, acute at apices; archegonia 180—220 μm long ................................................................. \textit{F. tosaensis}
34. Leaves narrowly lanceolate, acuminate at apices; archegonia 300 – 410 μm long — *F. incurvus*

**Ib. Fissidens subgen. Fissidens sect. Semilimbidium**

   - *Fissidens microcladus* was considered a synonymy of *F. gardneri* by Pursell et al. (1993).
   - However, the peristome teeth of *F. microcladus* are *Fissidens*-type, whereas *F. gardneri* has *Moenkemeyera*-type peristome teeth. I consider *F. microcladus* to be synonymous with *F. pallidinervis*.

2. *Fissidens pseudoceylonensis* B. C. Tan & Choy M.-S., J. Bryol. 24: 48 (2002). Fig. 7.
   - Plants small, yellow green. Stems 2 – 3 mm long, 1.5 – 2.6 mm wide with leaves, axillary hyaline nodules not differentiated; cortical cells in cross section small, thick walled; central strand weakly differentiated. Leaves in 5 – 9 pairs, upper leaves oblong lanceolate to broadly lanceolate, 1.2 – 1.8 mm long, 0.3 – 0.5 mm wide, acute to mucronate; base of dorsal lamina wedge shaped, ending well above insertion, not decurrent; costa subpercurrent; margin crenulate by projecting cells; vaginant laminae about 3/5 of leaf length; limbidia found only on vaginant laminae, composed of hyaline, elongate cells in 5 – 10 rows; laminae unistratose; cells of apical lamina irregularly hexagonal to quadrate, 8 – 11 μm long, papilllose, with 1 – 3 papillae per cell, moderately thick walled.
   - Autoicous; perigonia in leaf axils; perichaetial plants and sporophytes not found.
   - Additional description: Suzuki & Iwatsuki 2010, 16, f. 5.
   - Specimen examined. Ryukyu, Okinawa Isl., Nago-cho, Ohurakawa, Amano 8789 in NICH.
   - Distribution: Malaysia, Singapore and Indonesia; **new to Japan** (Ryukyu).

**Key to the species of subgen. Fissidens sect. Semilimbidium in Japan**

1. Laminal cells smooth, more or less weakly mammillose — *F. amoenus*  
2. Laminal cells mammillose or papillose — *F. pseudoceylonensis*  
3. Cells of apical laminae 10 – 14 μm long with a small indistinct papilla — *F. schwabei*  
4. Laminal cells highly mammillose and usually with 1 (rarely 2) papillae — *F. crenulatus*  
5. Laminal cells with 1 – 3 papillae; setae smooth — *F. pseudohollianus*  
6. Setae more or less scabrous; perigonia in axils of leaves — *F. hollianus*  
7. Lower leaves distant; upper leaves oblong lanceolate to lanceolate — *F. pseudohollianus*  
8. Lower leaves imbricate to base of stem; upper leaves narrowly lanceolate or linear lanceolate — *F. pseudohollianus*  
9. Lower leaves narrowly lanceolate, acuminate at apices; archegonia 300 – 410 μm long — *F. incurvus*
8. Costae percurrent .............................................. F. kurzii
8. Costae ceasing below apices .................................. F. pallidinervis
9. Capsules inclined and asymmetrical ................................ F. curvato-wichurae
9. Capsules erect and symmetrical ........................................... 10
10. Axillary hyaline nodules indistinct; limbidia restricted to the upper and perichaetial leaves ...........................................
10. Axillary hyaline nodules weakly differentiated; limbidia distinct on most leaves .................................... F. wichurae

Ic. Fissidens subgen. Fissidens sect. Aloma

Plants small, light green. Stems 2.6−3.8 mm long, 1.2−2.0 mm wide with leaves, axillary hyaline nodules not differentiated; cortical cells in cross section small, thick walled; central strand slightly differentiated. Leaves in 6−13 pairs, upper leaves oblong lanceolate, 0.8−1.3 mm long, 0.2−0.3 mm wide, acute to mucronate; base of dorsal lamina wedge shaped, not decurrent; costa stout, percurrent or ending 2−3 cells below the apex; margins serrate, unbordered; vaginant laminae about 1/2 of leaf length, somewhat unequal; laminae unistratose; cells of apical lamina irregularly hexagonal to quadrate, 7.5−15.0 μm long, slightly mammillose, thin walled; marginal cells appear distinctly paler than inner cells.

Perigonal plants and sporophytes not found.

Additional description: Sharp et al. 1994, 45, f. 30, e−i.

Specimens examined. Honshu, Tochigi-ken, Nikko-shi, Yamakubo, Kiso, 450 m alt., on tree trunk, Kamiyama 10985, 10999.

Distribution: Mexico, Costa Rica, Brazil and Ecuador; new to Japan (Honshu).

Fissidens platyphyllus was considered a synonymy of F. amoenus Müll. Hal. However, leaves of F. platyphyllus are unbordered, while those of F. amoenus are limbate on vaginant laminae of perichaetial leaves.

2. Fissidens takayukii Tad. Suzuki, n. sp. Figs. 9, 10.

Plants light green to dark green. Protonemata not persistent. Stems very short, 0.75−0.88 mm long with leaves; cortical cells in cross section small and thick walled, central strand not differentiated. Upper leaves oblong-ovate to oblong lanceolate, 0.5−0.9 mm long, more or less clasping, narrowly acute; costa weak and ill-defined, starting usually half-way up the sheath, percurrent, Thorsbornei-type in cross section; margin finely serrate throughout; laminae unistratose; upper laminal cells irregularly quadrate to hexagonal, 12−32 μm long, smooth, thin walled.

Rhizoautoicous; perigonia at base of stem; setae terminal, about 2 mm long; capsules erect and symmetrical; urn 0.4−0.6 mm long; exothecial cells rectangular with thickened longitudinal walls and thinner transverse walls, 15.0−27.5 μm long, 9.0−17.5 μm wide; opercula conic-rostrate, 0.3−0.4 mm long; peristome teeth 200−325 μm long, 40−45 μm wide at base, Fissidens-type; spores 11.0−12.5 μm in diam., smooth; calyptrae cucullate, 0.40−0.55 mm long, not papillose.

Distribution: **Endemic to Japan** (Honshu).

This new species is similar to *Fissidens erecto-thorsbornei* (Suzuki, 2014). Both species have without differentiated vaginant laminae, *Thorsbornei*-type costae and, erect and symmetrical capsule. However, leaves of *F. takayukii* are oblong-ovate to oblong lanceolate, while those of *F. erecto-thorsbornei* are linear-subulate from oblong base. Exothecial cells of *F. takayukii* are rectangular with thick, longitudinal walls and thin transverse walls, while those of *F. erecto-thorsbornei* are rounded quadrate to hexagonal, thin-walled, and distinctly collenchymatous.

**Key to the species of subgen. *Fissidens* sect. *Aloma* in Japan**

1. Leaves without differentiated vaginant laminae; costa starting usually halfway up the sheath (ecostae in the lower part of the sheath) .................................................. *F. takayukii*
   1. Leaves well differentiated vaginant laminae; costa well developed, continuous from sheathing base ................................................................. 2

   2. Protonema persistent; plants tiny, almost stemless ........................................................................... *F. protonemaecola*

   2. Protonema not persistent; plants of various sizes ................................................................................. 2

3. Laminal cells distinctly unipapillose ................................................................. 4

3. Laminal cells slightly mammillose or smooth .......................................................... 6

4. Margin of vaginant laminae distinctly and irregularly spinose serrate; costae ceasing 2–4 cells below apices .................................................................................. *F. tenellus* var. *australiensis*

4. Margin of vaginant laminae evenly serrate; costae percurrent to shortly excurrent .............................................................. 5

5. Vaginant laminal cells longer with 4–6 intralaminal rows irregularly elongate ........ 4

   5. Cells of vaginant laminae not as above .......................................................................................... *F. serratus*

   6. Plants small, less than 1.5 mm long including leaves ................................................................. 7

   6. Plants small to fairly large, more than 2 mm long including leaves ............................................... 9

7. Plants bud-like ............................................................................................................................. *F. flabellulus*

7. Plants not bud-like .......................................................................................................................... 8

8. Dorsal laminae lacking or reduced; costae excurrent as awns ........................................ *F. pseudoclosteri*

8. Dorsal laminae present; costae ceasing below apices ........................................... *F. closteri* subsp. *kiusiuensis*

9. Marginal cells on leaves appear distinctly paler than inner cells ........................................ *F. platyphyllus*

9. Marginal cells not as above ........................................................................................................... 10

10. Peristome teeth *Moenkemeyera*-type ......................................................................................... *F. neomagofukui*

10. Peristome teeth *Fissidens*-type .................................................................................................. 11

11. Vaginant laminal cells with 2–3 intralaminal rows, irregularly elongate ............................... *F. exilis*

11. Vaginant laminal cells not as above ............................................................................................ 12

12. Costae often bent at junction of vaginant laminae; base of dorsal laminae slightly decurrent on
stem ................................................................. \textit{F. ganguleei}

12. Costae straight to almost straight at junction of vaginant laminae; base of dorsal laminae not
decurrent ................................................................. 13

13. Cells of apical laminae thick walled; margins of lamina often 2 cells thick \textbf{........... F. crassinervis}

13. Cells of apical laminae thin walled to thick walled; laminae always unistratose ........................................ 14

14. Costae ceasing below apices ................................................................. \textit{F. pellucidus}

14. Costae percurrent ..............................................................................

15. Leaf margins nearly entire; cells of apical laminae rounded quadrate to elliptical, thick walled \textbf{........... F. guangdongensis}

15. Leaf margins serrulate; cells of apical laminae irregularly hexagonal, thin walled \textbf{........... F. laxitextus}

\textbf{IIa. Fissidens subgen. Pachyfissidens sect. Pachyfissidens}


\textit{Fissidens boninensis} Z. Iwats. which was recorded only from Bonin Islands was found in
Ibaraki-ken (Honsu).

Specimens examined. Honshu, Ibaraki-ken, Naka-shi, To, 20 m alt., on rock, submerged in stream,
Kamiyama 8368, 8369, 8375, 8376, 8773 – 8776.

\textbf{IIb. Fissidens subgen. Pachyfissidens sect. Serridium}

1. \textit{Fissidens kiguchii} Tad. Suzuki, \textit{n. sp.} Fig. 12.

Plants large for the genus, dark green, often blackish below, rigid. Stems usually creeping
or hanging from wet or dripping rocks, 30 – 60 mm long, 5.0 – 5.5 mm wide with leaves;
simple or with few branches; axillary hyaline nodules not well differentiated; cortical cells in
cross section small and thick walled; central strand well differentiated. Leaves in 38 – 64 pairs,
imbricate; middle to upper leaves narrowly lanceolate, 3.2 – 4.3 mm long, 0.4 – 0.5 mm wide,
acute; base of dorsal lamina distinctly decurrent on stem; vaginant laminae 1/2 – 3/5 the leaf
length, upper portion unequal and open to costa; costa stout, ceasing a few cells below apex,
\textit{Nobilis}-type in cross section; apical and dorsal laminae usually bistratose; leaf margin
bordered throughout by darker colored band of 1 – 3 cell-rows (more clearly so when treated
with KOH), irregularly dentate to coarsely serrate; cells of apical lamina quadrate to hexagonal,
10 – 18 \textmu m long, smooth, thick walled.

Dioicus?; male plants and sporophytes unknown.

Specimen examined. Ryukyu. Isl. Okinawa-ken, Kunigami-son, on cliff, \textit{Kiguchi 300803}, holotype
(NICH).

Distribution: \textbf{Endemic to Japan} (Ryukyu).

This new species is similar to \textit{Fissidens nobilis} Griff. However, cells of apical lamina of
\textit{F. kiguchii} are 10 – 18 \textmu m long, smooth, while those of \textit{F. nobilis} are 6 – 13 \textmu m long, some
cells highly mammillose.

\textbf{Key to the species of subgen. Pachyfissidens sect. Serridium in Japan}

1. Costae covered and obscured above by short, green cells ........................................ \textit{F. subbasilaris}
1. Costae not as above ................................................................. 2
2. A few rows of cells at leaf margins of apical laminae lighter and smooth, markedly different from inner cells as a pale band ................................................................. 3
2. Marginal cells on leaves not as above, usually not different from inner cells, or if different, then darker ................................................................. 7
3. Small to medium sized plants, stems less than 10 mm long including leaves; margins of apical laminae serrulate; cells of vaginant laminae with 3—4 papillae at corners ........................ F. teysmannianus
3. Large plants, stems more than 10 mm long including leaves; margins of apical laminae irregularly dentate to coarsely serrate in apical region; cells of vaginant laminae slightly mammillose, papillae absent or indistinct ................................................................. 4
4. Plants synoicous ................................................................. 5
4. Plants dioicous ................................................................. 5
5. Cells of apical laminae 7.5—22 μm long; pale margins of leaves slightly to moderately distinct ………… 6
5. Cells of apical laminae 6—10 μm long; pale margin of leaves usually distinct .......................... F. dubi
6. Cells of apical laminae 7.5—15 μm long, conical mammillose .................................................. F. serrulatus
6. Cells of apical laminae 13—18—(22) μm long, weakly mammillose ........................................ F. adianthoides
7. Leaf margins dark ................................................................. 8
7. Cells of leaf margins not different from other laminal cells ................................................................. 8
8. Leaf margins usually unistratose; costae Bryoides-type in cross section .............................. F. bourgaeanus
8. Leaf margins 2—4 cells thick; costae Nobilis-type in cross section ........................................ 9
9. Cells of apical lamina some cells highly mammillose, 6—13 μm long ........................................ 10
9. Cells of apical lamina smooth, 10—18 μm long ................................................................. F. nobilis
10. Leaf bases decurrent on stem ................................................................. 11
10. Leaf bases not decurrent on stem ................................................................. 12
11. Cells of vaginant laminae with 1—4 papillae at corner ................................................................. 13
11. Cells of vaginant laminae mammillose ................................................................. F. kiguchii
12. Laminal cells smooth or slightly mammillose ................................................................. 13
12. Laminal cells papillose or distinctly mammillose ................................................................. 14
13. Central strand not differentiated .................................................................. 15
13. Central strand differentiated .................................................................. 15
14. Cells of apical lamina 9—15 μm long; central strand weakly differentiated ........................................ F. polypodioides
14. Cells of apical lamina 13—18—(22) μm long; central strand well differentiated ........................................ F. polypodioides
15. Leaf apices obtuse to obtusely acute; costae ceasing several cells below leaf apices ………… F. obscurus
15. Leaf apices apiculate; costae excurrent into apiculi ................................................................. F. aphelotaxifolius
16. Cells of vaginant laminae with 1—4 papillae at corners ................................................................. 17
16. Cells of vaginant laminae with one central papilla or mammilla ................................................................. 17
17. Stems with leaves to 30 mm long, 2—3 mm wide ................................................................. F. elongatus
17. Stems with leaves 3—10 mm long, 2.4.5 mm wide ................................................................. 18
18. Upper leaves narrowly lanceolate, often cultriform ................................................................. F. pseudoadelphinus
18. Upper leaves lanceolate to oblong lanceolate, never cultriform ................................................................. 19
19. Cells of apical laminae 13—26 μm long ........................................................................ F. fujiiens
19. Cells of apical laminae 6—13 μm long ........................................................................ F. teysmannianus
20. Juxtacostal cells at base of vaginant laminae abruptly and conspicuously enlarged € F. gedehensis

20. Juxtacostal cells at base of vaginant laminae not as above € 21

21. Setae lateral or basal; perichaetial leaves much smaller than stem leaves € F. taxifolius

21. Setae and perichaetial terminal, perichaetial leaves not different from stem leaves € 22

22. Medium sized to large plants; stems 15 – 50 mm long, 3.5 – 7.5 mm wide including leaves; costae percurrent € F. involutus

22. Small to medium sized plants; stems 2.5 – 14 mm long, 1.9 – 3.5 (rarely to 4.7) mm wide including leaves; costae ceasing below apex € 23

23. Cells of apical laminae 8 – 10 – (12) μm long, distinctly mammillose, with indistinctly demarcated walls; perigonial plants small, growing in vaginant laminae of perichaetial plant... € F. gymnogynus

23. Cells of apical laminae 13 – 16 – (17) μm long, more or less mammillose, usually with well demarcated walls; perigonial plants similar to perichaetial plants € F. osmundoides

Acknowledgements

I am grateful to Dr. B. C. Tan for correcting the English text and for valuable suggestions. I am much indebted to Mr. Takayuki Kamiyama and Mr. Hiroshi Kiguchi who collected the specimens and provided them to me for a study. Grateful acknowledgement is made of the financial support for this study provided by Grant-in-Aid for Scientific Research (C) (no. 16570086) by the Japan Society for the Promotion of Science.

Literature cited


Suzuki, T. & Z. Iwatsuki. 2010. Fissidens (Fissidentaceae, Bryopsida) collections made by Mr.
Fig. 1. *Fissidens crispus* Mont.: a, plant. b,c, leaves. d, cells at leaf apex. e, cells of apical lamina. f, cells at margin of dorsal lamina. g, cells at margin of vaginant lamina. h, i, cross sections of leaves. j, cross section of stem. k, perigonium. l, exothecial cells. m, stoma. n, apical portion of peristome tooth. o, spores. p, calyptra. All figures drawn from Kamiyama 7588 in NICH.
Fig. 2. *Fissidens excurrentinervis* R. S. Williams: a, fertile plant. b, sterile plant. c, leaf. d, cells at leaf apex. e, cells of apical lamina. f, cells at margin of vaginant lamina. g, cross section of leaf. h, cross section of stem. i, capsule. j, peristome teeth and spores. All figures taken from Kamiyama 10069 in NICH.
Fig. 3. *Fissidens perssonii* P. de la Varde: a, plants. b, leaf. c, cells of apical lamina. d, cells at margin of dorsal lamina. e, cells at margin of vaginant lamina. f, g, cross sections of leaves. h, cross section of stem. i, apical portion of peristome tooth. j, spores. All figures taken from Kamiyama 9325 in NICH.
Fig. 4. *Fissidens sublineaeofolius* (P. de la Varde) Brugg.-Nann.: a, plants. b, leaf. c, cells at leaf apex. d, cells at margin of vaginant lamina. e, cross section of leaf. f, cross section of stem. g, apical portion of peristome tooth. h, spores. All figures taken from Kamiyama 9079 in NICH.
Fig. 5. *Fissidens taylorii* Müll. Hal.: a, b, fertile plant. c, sterile plant. d, leaf. e, cells at leaf apex. f, cells at margin of vaginant lamina. g, cross section of leaf. h, cross section of stem. i, capsule. j, operculum. k, peristome teeth. All figures taken from Kamiyama 9987 in NICH.
Fig. 6. *Fissidens ventricosus* Lesq.: a, plant. b, leaf. c, cells at leaf apex. d, cells of apical lamina. e, cells at margin of vaginant lamina. f, g, cross sections of leaves. h, cross section of stem. i, capsule. j, peristome teeth. k, apical portion of peristome teeth. All figures taken from *Kamiyama 10055* in NICH.
Fig. 7. *Fissidens pseudoceylonensis* B. C. Tan & Choy M.-S.: a, plant. b, leaf. c, cells at leaf apex. 
d, cells of apical lamina. e, cells at margin of vaginant lamina. f, cross section of leaf. g, cross section of 
stem. All figures taken from *Amano 8789* (NICH).
Fig. 8. *Fissidens platyphyllus* Broth.: a, plant. b, leaf. c, cells at leaf apex. d, cells of apical lamina. e, cells at margin of vaginant lamina. f, cross section of leaf. g, cross section of stem. All figures taken from Kamiyama 10999 in NICH.
Fig. 9. *Fissidens takayukii* Tad. Suzuki, n. sp.: a, b, plants. c, leaf. d, cells at leaf apex. e, cells at sheathing base of leaf. f, cross section of leaf. g, cross section of stem. h, capsule. i, apical portion of peristome teeth. j, spores. k, calyptra. All figures taken from holotype (*T. Suzuki 61890* in NICH).
Fig. 10. *Fissidens takayukii* Tad. Suzuki, n. sp.: a, plant. b, c, leaves. d, cells at leaf apex. e, cells at margin of sheathing base of leaf. f, cross section of leaf. g, cross section of stem. h, perigonial plant. i, operculum. j, exothecial cells. k, stoma. l, apical portion of peristome tooth. m, spores. n, calyptra. o, cells of upper part of calyptra. All figures drawn from *Kamiyama 7766* in NICH.
Fig. 11. *Fissidens boninensis* Z. Iwats.: a, plants. b, leaf. c, cells at leaf apex. d, cells of apical lamina. e, cells of vaginant lamina. f, g, cross sections of leaves. All figures taken from Kamiyama 8376 in NICH.
Fig. 12. *Fissidens kiguchii* Tad. Suzuki, n. sp.: a, plants. b, leaf. c, cells at leaf apex. d, cells of apical lamina. e, cells at margin of vaginant lamina. f, cross section of leaf. g, cross section of stem. All figures taken from holotype (*Kiguchi 300803* in NICH).