

FULL PAPER

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## Bambusicolous fungi in Japan (6): *Katumotoa*, a new genus of phaeosphaeriaceous ascomycetes

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**Abstract** A new genus, *Katumotoa*, is established for a single species, *K. bambusicola*, collected from culms of *Sasa kurilensis*. Morphological differences between *Katumotoa* and some related genera are noted. *Katumotoa* is characterized by perithecioid ascomata, thin ascomal wall composed of small pseudoparenchymatous cells, cellular pseudo-paraphyses, fissitunicate asci, and apiosporous fusiform ascospores with bipolar mucilaginous sheath. From these features, it is considered that the genus belongs to Phaeosphaeriaceae in Pleosporales.

**Key words** Bamboo · Phaeosphaeriaceae · Pleosporales · *Sasa* · Taxonomy

### Introduction

In the fungal foray held at the foot of Mt. Iwate by the Mycological Society of Japan in 2003, an interesting ascomycete was collected on culms of *Sasa kurilensis* (Rupr.) Makino & Shibata. It has several morphological features resembling those of fungi in Pleosporales but cannot be accommodated in any of the existing genera in the order. Therefore, we describe a new genus, *Katumotoa*, to place a single species, *K. bambusicola*.

Methods for microscopic observation, single ascospore isolation, and cultivation followed Tanaka and Harada (2003). Specimens cited in this article were mainly maintained at the Herbarium of Hirosaki University, Fungi (HHUF), and some isotype and paratype materials were preserved at the herbarium of TNS-F (The National Science Museum, Tokyo). A culture strain was deposited at the culture collections of MAFF (National Institute of Agrobiological Science, MAFF Genebank) and JCM (Japan Collection of Microorganisms, Riken).

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### Taxonomy

***Katumotoa*** Kaz. Tanaka & Y. Harada, gen. nov.

Ascomata unilocularia, subglobosa, dispersa vel congregata, immersa vel erumpentia, ostiolata. Apicem ascomatis brevis, centralis. Parietis ascomatis pseudoparenchymaticus, ex cellulis hyalinis vel pallide brunneis parvis compositus. Pseudoparaphyses cellulosa, copiosae, septatae, ramificantes et anastomosantes. Asci copiosi, bitunicati, fissitunicati, clavati, apice rotundati, camera apicali formantes, stipitati, basales et partim laterales, octospori. Ascospores fusiformes, asymmetricae, septo primo ad submedium formantes, hyalinae, laeves, cum vagina gelatinosa obtectae.

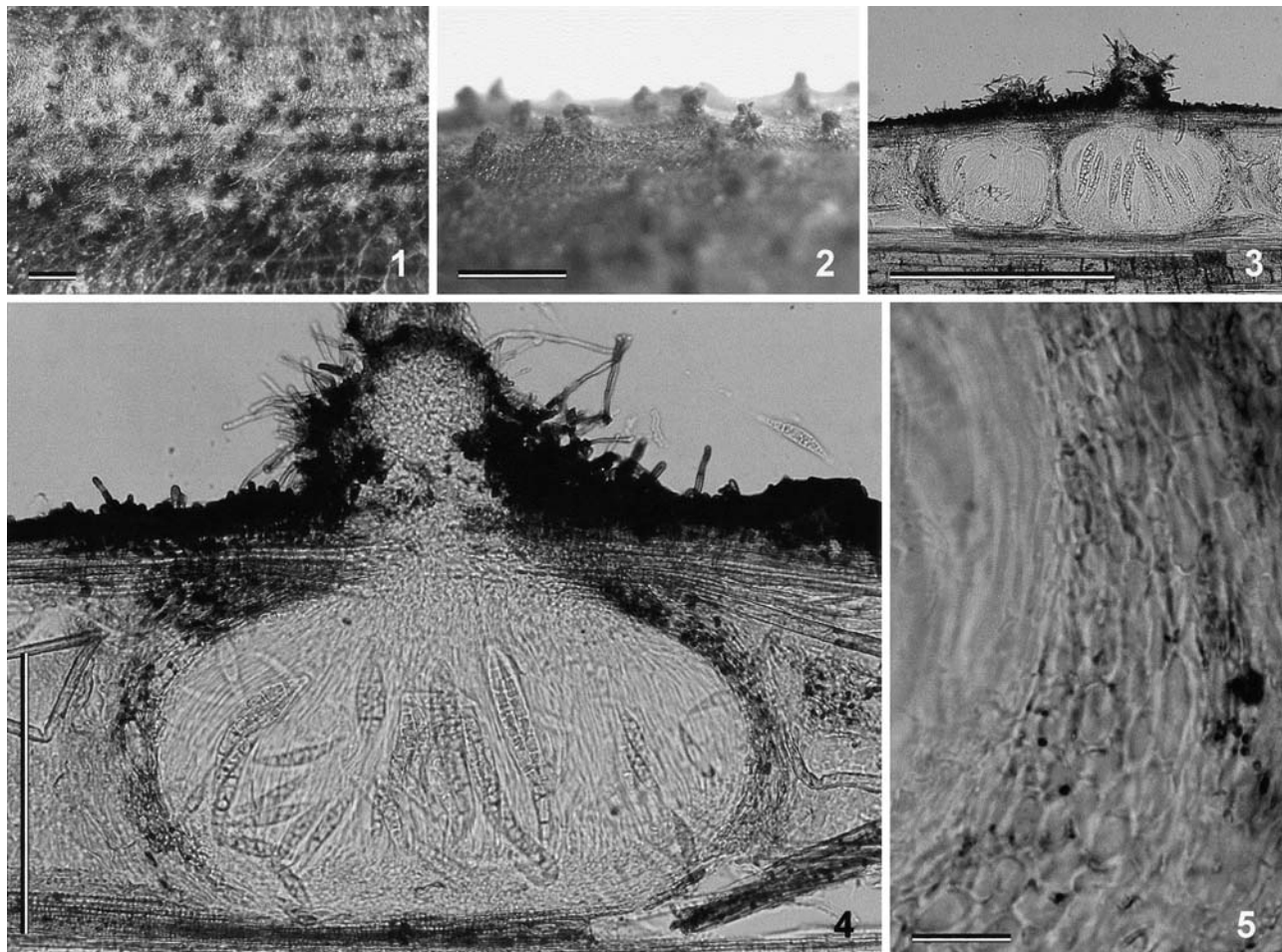
Etymology: Named in honor of Dr. Ken Katamoto for his distinguished taxonomic work on bambusicolous fungi.

Species typica: *Katumotoa bambusicola* Kaz. Tanaka & Y. Harada.

Ascomata uniloculate, subglobose, scattered to crowded, immersed or erumpent, with a rounded ostiole. Ascomatal apex short, central. Ascomatal wall composed of hyaline to pale brown small pseudoparenchymatous cells. Pseudoparaphyses cellular, numerous, septate, branched and anastomosed. Asci numerous, bitunicate, fissitunicate, clavate, at the apex rounded and with a shallow apical chamber, short stalked, basal and somewhat lateral, 8-spored. Ascospores fusiform, asymmetric, with a submedian primary septum, hyaline, smooth, usually with bipolar mucilaginous sheath. Senescent ascospores 2–4-septate, reddish-brown at the middle cell, pale yellow at others, echinulate.

***Katumotoa bambusicola*** Kaz. Tanaka & Y. Harada, sp. nov. Figs. 1–23

Ascomata 230–350 μm alta, 260–440 μm diametro, unilocularia, subglobosa, dispersa vel congregata, immersa, ad apicem erumpentia, ostiolata. Apicem ascomatis 80–150 μm longum, 85–125 μm latum, brevis, centralis. Parietis ascomatis 12.5–30 μm crassus, ex cellulis 4–6-stratis polygonis hyalinis vel pallide brunneis 5–20 × 2.5–6.5 μm



**Fig. 1–5.** Ascomata of *Katumotoa bambusicola* from culture (on sterilized rice straws). **1, 2** Ascomata on the surface of rice straws. Note the short papillate ascomatal apex. **3, 4** Sections of ascomata, surrounded

by hyaline hyphae or undifferentiated cells. **5** Ascomal wall of small, hyaline to pale brown cells. All from the holotype (HHUF 28663). **Bars 1, 2** 1 mm; **3** 500  $\mu$ m; **4** 200  $\mu$ m; **5** 20  $\mu$ m

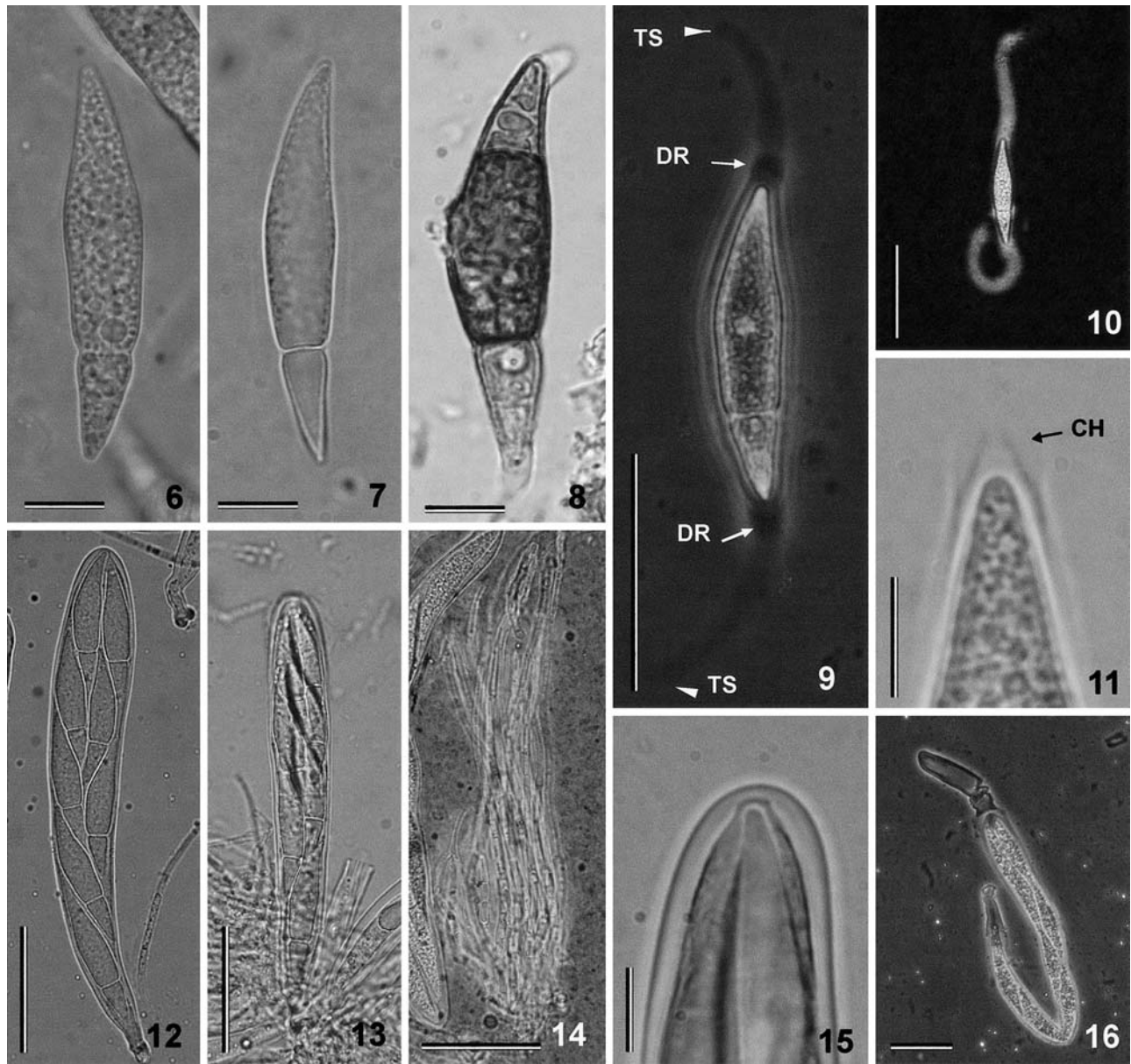
compositus. Pseudoparaphyses cellulosa, copiosa, 1.5–4  $\mu$ m latae, septatae, ramificantes et anastomosantes, inter septa 10–30  $\mu$ m longae, in materia gelatinosa. Asci (114–)130–178(–199)  $\times$  (17–)19.5–25.5  $\mu$ m, copiosi, bitunicati, fissitunicati, clavati, apice rotundati, camera apicali formantes, stipitati, basales et partim laterales, octosporis. Ascospores (39.5–)44–51.5(–54)  $\times$  (7–)8–10.5(–13)  $\mu$ m, fusiformes, fere curvatae, asymmetricae, ad septum primo submedio constrictae, hyalinae, guttulate, cum vagina gelatinosa, obtectae.

Etymology: In reference to the host plant.

Holotypus: HHUF 28663.

Ascomata 230–350  $\mu$ m high, 260–440  $\mu$ m in diameter, uniloculate, subglobose, scattered to crowded, immersed and erumpent at the apex, with a rounded ostiole (Figs. 1–4). Ascomatal apex 80–150  $\mu$ m long, 85–125  $\mu$ m wide, short papillate, central. Ascomatal wall uniformly 12.5–30  $\mu$ m thick, composed of 4–6 layers of polygonal hyaline to pale brown pseudoparenchymatous cells of 5–20  $\times$  2.5–6.5  $\mu$ m, covered by hyaline hyphae or poorly developed polygonal to globose cells at sides (Fig. 5). Pseudoparaphyses cellular,

numerous, 1.5–4  $\mu$ m thick, straight, septate at 10–30  $\mu$ m intervals, branched and anastomosed, with clearly mucilaginous coating (Fig. 14). Asci (114–)130–178(–199)  $\times$  (17–)19.5–25.5  $\mu$ m (mean = 154.2  $\times$  21.1  $\mu$ m,  $n$  = 50), numerous, bituncate with fissitunicate dehiscence, clavate, at the apex rounded and with a shallow apical chamber, short stalked (8–33  $\mu$ m; mean = 17.8  $\mu$ m,  $n$  = 43), basal and somewhat lateral, with 8 ascospores biserial above and uniserial below (Figs. 12, 13, 15, 16, 23D). Ascospores (39.5–)44–51.5(–54)  $\times$  (7–)8–10.5(–13)  $\mu$ m (mean = 47.6  $\times$  9.5  $\mu$ m,  $n$  = 100), L/W 4.4–5.7 (mean = 5.0,  $n$  = 100), fusiform with acute ends, mostly curved, asymmetrical, with a submedian septum at 0.67–0.73 (mean = 0.70,  $n$  = 100) and strongly constricted, sometimes formed a secondary septum at about 0.27–0.35, widest at the middle portion of the upper cell, hyaline, with small guttules, smooth, with a mucilaginous sheath. Sheath bipolar, 10–17  $\mu$ m long, 1–2  $\mu$ m thick at sides of ascospores, weakly constricted at near the primary septum, slightly enlarging in water up to 60  $\mu$ m long, with dense zones (about 2–4  $\mu$ m in diameter) provided with conelike chamber (about 1–2  $\mu$ m long) near both ends of ascospores (Figs. 6, 7,



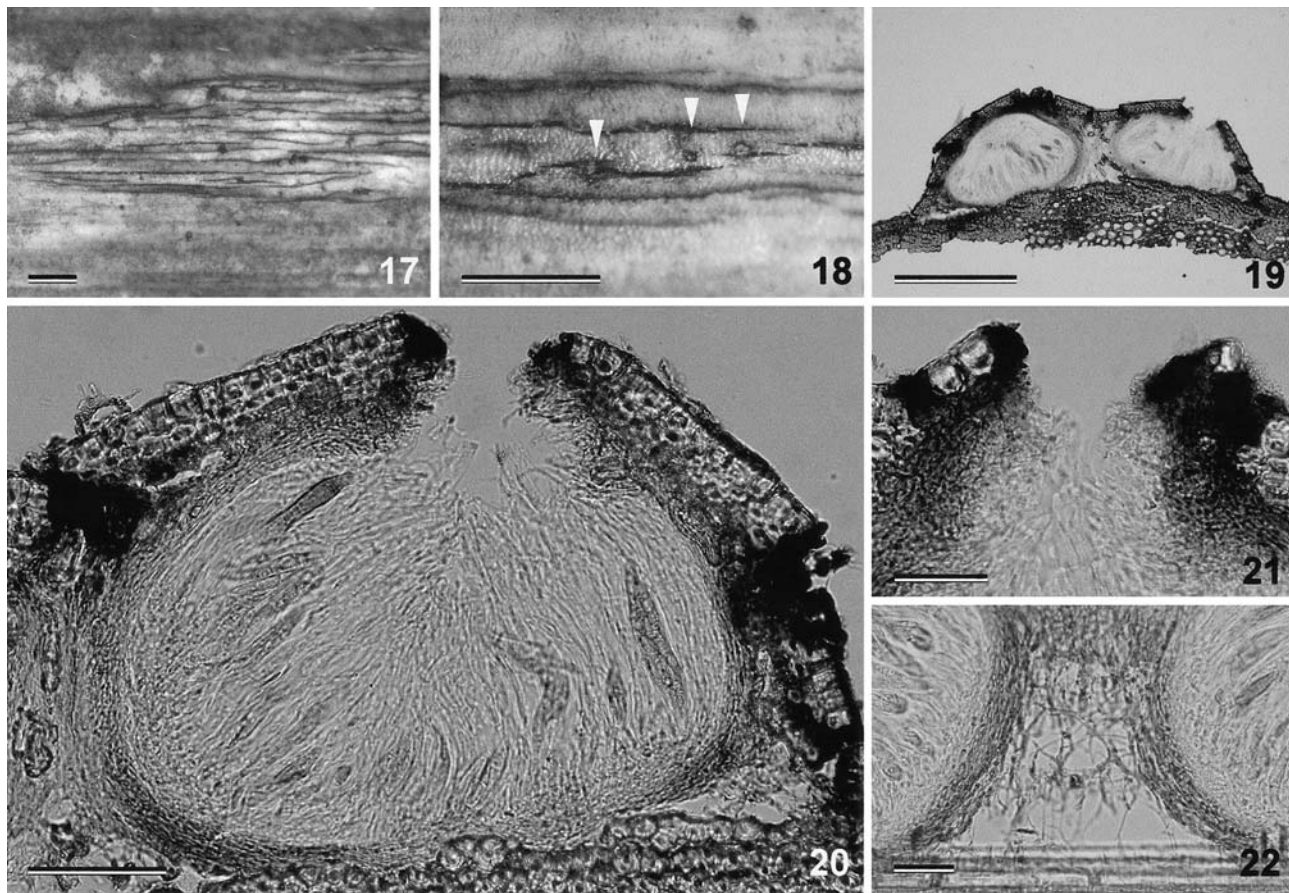
**Fig. 6–16.** Ascospores, asci, and pseudoparaphyses of *Katumotoa bambusicola*. **6, 7** Mature ascospores. **8** Senescent ascospore. **9** Ascospore with bipolar sheath. Note the dense regions (*DR*) at near the ends of ascospore and the tips of bipolar sheath (*TS*). **10** Enlarged sheath of ascospore in water with India ink. **11** Cone-shaped chamber

at the end of ascospore (*CH*). **12, 13** Asci. **14** Cellular pseudoparaphyses. **15** Ascus apex with a shallow ocular chamber. **16** Ascus with fissitunicate dehiscence. All from the holotype (HHUF 28663), except **7, 8, 13** from specimen on *Sasa* (HHUF 28661). Bars **6–8, 11, 15** 10 $\mu$ m; **9, 10, 12–14, 16** 50 $\mu$ m

9–11, 23A,B). Senescent ascospores 2–4-septate, reddish-brown and rarely appearing muriform at the middle cell, pale yellow at others, echinulate (Figs. 8, 23C).

Cultural characteristics: Ascospores germinating from one or both ends or middle region. Colonies on potato dextrose agar (Difco, Detroit, MI, USA) 75 mm in diameter after 4 weeks at 20°C in the dark, Olive-Grey (2D2; Kornerup and Wanscher 1978) to Olive (2D3), lanose, with white margin; reverse Bluish-Grey (22F3) to Olive (1F3); no pigment produced. On rice straw agar (Tanaka and Harada 2003), an ascomal state formed on the surface of rice straws within 2 months.

Materials examined: On culms of *Sasa kurilensis*: Japan, Mt. Iwate, near Yakebashiri, Hirakasa, Nishine, Iwate (141°02' E, 39°52' N), Oct. 19, 2003, K. Tanaka 1517a (HHUF 28661); 1517b (TNS-F 11264); 1517c (HHUF 28662). Cultured specimens grown on culms of *Oryza sativa* L., made from culture MAFF 239641 = JCM 13131: c1517-1 (HHUF 28663, holotype); c1517-2 (TNS-F 11263, isotype); c1517-3 (HHUF 28664, isotype); c1517-4 (HHUF 28665). Single ascospore culture isolated from HHUF 28661 (MAFF 239641 = JCM 13131).



**Fig. 17–22.** Ascomata of *Katumotoa bambusicola* on culms of a natural host, *Sasa kurilensis*. **17, 18** Ascomata on culm surface. Note the rounded ostioles (**18**, arrowheads). **19, 20** Section of ascomata. **21** Short

ascomatal apex. **22** Ascomal walls and sparse hyphae between ascomata. All from HHUF 28661. Bars **17, 18** 1 mm; **19** 500 µm; **20** 200 µm; **21, 22** 50 µm

## Discussion

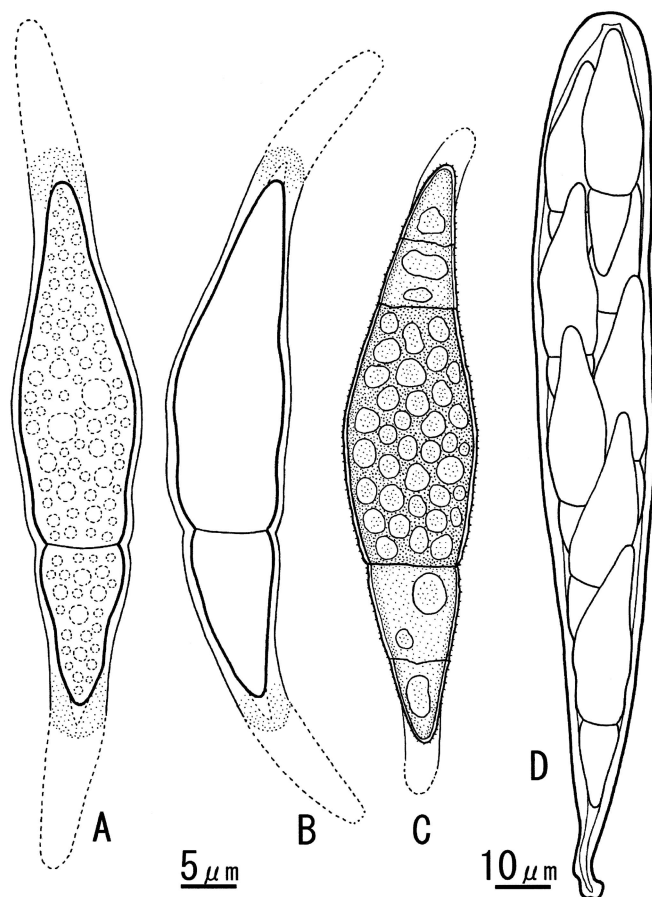
Our collected fungus on *S. kurilensis* was in slightly overmature condition. The ascospores were mostly brownish with more than one septum. However, some fresh ascospores germinated on water agar, and we were able to obtain a single ascospore isolate. In culture, the fungus produced numerous ascomata containing hyaline mature ascospores on sterilized rice straws immersed in water agar. Therefore, we chose a cultured specimen as the holotype (HHUF 28663).

There were several differences in the ascomatal morphology between cultured specimens and that from nature. The description of this fungus is given primarily from the culture specimen. The ascomatal morphology in nature is as follows (see Figs. 17–22): ascomata mostly larger, 310–510 µm in diameter, more depressed subglobose; ascomatal apex none or very short, 50–75 µm long; ascomatal wall 25–38 µm thick at sides, composed of 5–10 layers of more-flattened cells (5–15 × 1–3 µm), thinner at the base. In surface view, the ascomata on host are similar to those of *Phaeosphaeria brevispora* (Nagas. & Y. Otani) Shoemaker & C.E. Babc., which also is a bambusicolous fungus, in that

both have ascomata immersed in single or double rows along the long axis of the culms and forming many longitudinal fissures on the culm epidermis. As to ascospore morphology, we could observe some fresh ascospores from the field specimen (see Fig. 7), although the material was mostly in overmature condition (see Fig. 8). The fresh ascospores were almost identical with those from culture, and the measurements were 41–52 × (7–)8–9.5 µm (mean = 47.1 × 8.8 µm,  $n = 50$ ), L/W 4.7–6.1 (mean = 5.4,  $n = 50$ ), and with a submedian septum at 0.67–0.73 (mean = 0.71,  $n = 50$ ).

Several morphological characters of the present fungus, such as perithecioid ascomata, cellular pseudoparaphyses, bitunicate asci, and asymmetrical ascospores, indicated that it belongs to the Pleosporales (Barr and Huhndorf 2001). However, we have been unable to find an appropriate genus to accommodate it by reviewing the literature on bitunicate ascomycetes (e.g., von Arx and Müller 1975; Barr 1987; Eriksson 1981; Luttrell 1973; Sivanesan 1984) and didymosporous or apiosporous ascomycetes (e.g., Hyde et al. 1998; Müller and von Arx 1962). Thus, we erected a new genus *Katumotoa* for the fungus.

The most remarkable features of this fungus are the apiosporous ascospores and the bipolar enlarged sheath of ascospores. Many ascospores on host were 1–4-septate, with



**Fig. 23.** Line drawings of *Katumotoa bambusicola*. **A, B** Mature ascospores. Note the bipolar sheath and dense regions having cone-shaped chambers. **C** Senescent ascospore with four septa and brownish midcell. **D** Ascus. **A, B, D** from HHUF 28663; **C** from HHUF 28661

brownish midcell and echinulate surface; probably they were in senescence (see Figs. 8, 23C). In mature and fresh condition in culture, the ascospores were hyaline, containing small guttules and with a submedian primary septum at the lower part of ascospores (see Figs. 6, 23A,B). The bipolar ascospore sheath begin to deliquesce and swell in water up to 60 $\mu$ m long (see Fig. 10), similar to that of some freshwater ascomycetes such as *Massarina ingoldiana* Shearer & K.D. Hyde (1997), *Macrospora scirpicola* (DC.: Fr.) Fückel (Ingold 1955), and *Phaeosphaeria vilasensis* Fallah, Shearer & Leuchtm. (1999), although the degree of extension is less in *K. bambusicola*. In the bipolar sheath, somewhat dense regions with a cone-shaped chamber are observed near both ends of ascospores (see Figs. 9, 11, 23A,B).

In terms of ascospore morphology, *Katumotoa* is similar to *Heptameria* Rehm & Thüm., a member of Dothideales (Kirk et al. 2001) or Leptosphaeriaceae in Pleosporales (Barr 1987, 1990). In *Heptameria*, however, the ascospores are many septate, and with a muriform midregion (Lucas and Sutton 1971). Moreover, the thick ascomatal peridium of *Heptameria* is composed of sclerotial-walled cells (Barr 1990). *Katumotoa* also slightly resembles *Asymmetricospora* J. Fröhl. & K.D. Hyde in its submedian ascospore shape, but the latter has large ascomata of uni- to multiloculus, carbonaceous ascomal wall, and trabeculate pseudoparaphyses (Fröhlich and Hyde 1998). Many species in *Lophiostoma* Ces. & De Not. have ascospores with a bipolar sheath similar to those of *Katumotoa*, but usually the ascospores are narrowly fusiform with a primary septum at nearly midposition (0.42–0.53; Tanaka and Harada 2003). *Lophiostoma* belonging to Lophiostomataceae in Pleosporales is characterized by the ascomata having a cristate or apically flattened neck and slitlike ostiole (Holm and Holm 1988). The ascomatal apex of *Katumotoa* is none

**Table 1.** Main morphological features of *Katumotoa* and similar genera

	<i>Katumotoa</i>	<i>Heptameria</i>	<i>Asymmetricospora</i>	<i>Lophiostoma</i>	<i>Manglicola</i>
Family	Phaeosphaeriaceae	Leptosphaeriaceae	Melanommataceae	Lophiostomataceae	Hypsostromataceae
Ascomata	Subglobose with a short neck, of small pseudoparenchymatous cells	Conoid with a short papillate neck, of small scleroplektenchymatous cells	Lenticular without differentiated neck, of carbonaceous irregular cells	Globose to subglobose with a flattened neck, of parallel prismatic cells	Elongate with a short cylindrical neck, of soft-textured pseudoparenchymatous cells
Hamathecium	Cellular	Cellular	Trabecular	Narrowly cellular	Trabecular
Ascospores	Fusiform, 1-septate, asymmetrical, hyaline, with bipolar sheath	Narrowly fusiform, 6–8-septate with a muriform midregion, asymmetrical at first, brown at midregion, subhyaline at ends, without sheath	Navicular to obovate, 1-septate, asymmetrical, hyaline, with entire sheath	Narrowly fusiform, 1–9-septate, symmetrical, hyaline to brown, with bipolar sheath or absent	Fusiform, 1–3-septate, asymmetrical or symmetrical, brown at upper or middle cells, pale at lower or end cells, with or without sheath
Anamorphs	Unknown	Coelomycetous	Unknown	<i>Pleurophomopsis</i>	Unknown
References	Present study	Barr (1990); Lucas and Sutton (1971)	Fröhlich and Hyde (1998)	Holm and Holm (1988); Tanaka and Harada (2003)	Huhndorf (1994); Kohlmeyer and Kohlmeyer (1971)

or very short and with a rounded ostiole. Except for the genera in Pleosporales, the outline of ascospores in *Katumotoa* is similar to that of *Manglicola* Kohlm. & E. Kohlm. (Dothideomycetidae, incertae sedis: Kirk et al. 2001), especially to *M. guatemalensis* Kohlm. & E. Kohlm. (1971), but the latter genus has elongate to lageniform ascomata and trabeculae (Huhndorf 1994). A synopsis of these differences is given in Table 1.

We consider that the genus *Katumotoa* belongs to the Phaeosphaeriaceae defined by Barr (1987, 1992) because it has immersed perithecioid ascomata, thin ascomal wall composed of small pseudoparenchymatous cells, cellular pseudoparaphyses, and fissitunicate asci.

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