

Notes on some plant-inhabiting fungi collected from the Nansei Islands (3)*

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Abstract In this paper, four plant-inhabiting fungi newly collected from the Nansei Islands, Japan, are reported. Among them, *Phaeodiscula tremae* Sawada from Tokunoshima Island was transferred to the genus *Capnodiastrum* and given a new name *C. sawadae*, because in the genus *Capnodiastrum*, the specific epithet *tremae* has already been used for the different South American species. *Nyssopsora formosana* on *Koelreuteria formosana* and *Pestalotiopsis fici* on *Ardisia quinquegona* collected in Okinawa Main Island and *Pseudocercospora acaciae-confusae* on *Acacia confusa* collected in Okinoerabu Island were newly recorded from Japan.

Keywords *Capnodiastrum sawadae* nom. nov. ·
Nyssopsora formosana · *Pestalotiopsis fici* ·
Pseudocercospora acaciae-confusae

Introduction

Nansei Islands are a group of many of islands located further south of Japan than the Kyushu Main Islands, and

most of them are in a subtropical climate. In our previous two papers (Kobayashi et al. 2003; Motohashi et al. 2010), seven fungi collected in Nansei Islands were recorded as new to Japan, and one was transferred to the genus *Phyllosticta* from *Strasseria*. In this paper, three fungi, *Nyssopsora formosana* (Sawada) Lütjeh. on *Koelreuteria formosana*, *Pestalotiopsis fici* Steyaert on *Ardisia quinquegona*, and *Pseudocercospora acaciae-confusae* (Sawada) Goh & Hsieh on *Acacia confusa* were described as new to Japan. The other one, *Phaeodiscula tremae* Sawada (1944) on *Trema orientalis* has now been transferred to the genus *Capnodiastrum* and given a new name, *C. sawadae* Tak. Kobay. & Ky. Watan., because the specific epithet *tremae* has been shared by old species *C. tremae* (Syd.) Petr. (1952).

Descriptions

9. *Capnodiastrum sawadae* Tak. Kobay. & Ky. Watan. nom. nov. Figs. 1, 2a–d
Synonym: *Phaeodiscula tremae* Sawada 1944, Rept. Taiwan Agr. Exp. Sta. 87:61, Pl.4: 18–19. non *Capnodiastrum tremae* (Syd.) Petr., 1952.

Capnodiastrum guaraniticum sensu Katumoto & Hara-da, Trans. Mycol. Soc. Jpn. 20: 423, 1979, non Spegazzini 1886.

Symptom and morphology (see Figs. 1 and 2a–d): Many small, dark brown to black fungal colonies develop mainly on the lower leaf surface as sooty patches. Diseased leaves turn pale yellow on the upper surface. The surfaces of fungal colonies are rough and granular with many minute pycnidia. Pycnidia are formed on short branches from the creeping hyphae on leaves, which are brown to dark brown

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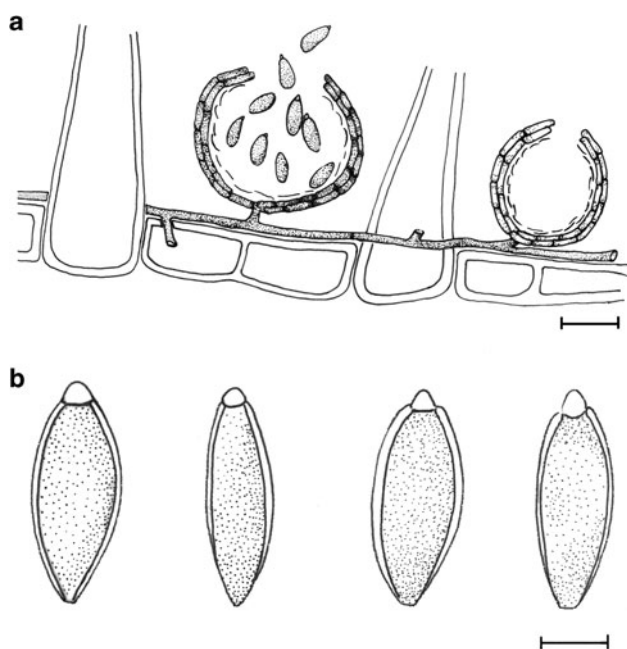


Fig. 1 *Capnodiastrum sawadae*. **a** Pycnidia and conidia on the lower leaf surface. **b** Brown matured conidia having small projection at the tip. Bars **a** 50 μm ; **b** 10 μm

and 4–6 μm in diameter. Young pycnidia are globular at first, then widely open and cup-shaped, 100–125 μm in diameter, with a dark brown wall composed of irregular-shaped cells and are 15–20 μm thick. Conidiogenous cells bear from the inner layer of the pycnidial wall and are hyaline to pale brown, small, conic, and produce conidia holoblastically. Conidia are elliptic to fusoid with a thick cell wall, truncate basal end, and rounded tip with a small, horn-like projection covered with a sticky cap, dark brown to sooty brown, often with a hyaline equatorial band, 27.5–35 \times 13.8–17.5 μm (32.38 \times 14.96 μm on average).

Disease name: Komaru-susu-byo in Japanese (Sawada 1944), Sooty granular spot.

Specimen examined: On living leaves of *Trema orientalis* Blume (Urajiro-enoki in Japanese), Japan: Mt. Inokawa, Tokunoshima, Kagoshima Pref., Nov. 9, 1993, by T. Kobayashi (TK) and M. Muramoto (TFM: FPH-8057). FORMOSA (=Taiwan): Jen-tzou Hot Spring, Ilan Prefecture, Taiwan, October 13, 1982; by Amano, N. (TNS-F 176491).

Taxonomic note: The present fungus was first described by Sawada (1944) from Formosa as *Phaeodiscula tremae* Sawada. The symptoms on the diseased leaves and the morphological characteristics of the fungus collected at Tokunoshima Island, Kagoshima Prefecture, were identical with those of Sawada. On the other hand, Katumoto and Harada (1979) reported quite similar fungus to *Phaeodiscula tremae* Sawada based on the diseased materials collected from Chichijima Island, Bonin Isles, Tokyo, as

Capnodiastrum guaraniticum Speg. as shown in Table 1. Morphological characteristics of these three fungous materials in question was not identical to those of the monotypic species *Phaeodiscula celottii* Cub. (Saccardo 1892; Kirk et al. 2008). The latter do not develop a mycelial mat on the leaf surface, in which pycnidia are densely formed and have long filamentous conidiophores. On the other hand, these three fungous materials equally develop many pycnidia within the blackish mycelial mat mainly on the lower leaf surface and produce conidia holoblastically from short conidiogenous cells. Morphological characteristics of these 3 fungous specimens well correspond to those of the genus *Capnodiastrum*, as Katumoto and Harada (1979) identified their fungus as a member of the genus *Capnodiastrum*.

The genus *Capnodiastrum* was established by Spegazzini in 1886 with 2 species. One is *C. guaraniticum* Speg., the type species and the other one is *C. paraguayensis* Speg., which was treated as a synonym of *C. guaraniticum* by Sutton (1980). As 4 species were added in this genus by Petrak (1952), a total of 5 species has been recognized in the genus *Capnodiastrum* (Kirk et al. 2008). Among them, *C. guaraniticum* and *C. tremae* (Syd.) Petr. were known on ulmaceous plants, *Celtis* or *Trema*. In Table 1 and Fig. 3, the dimensions of the fruiting bodies of these two species and *Phaeodiscula tremae* are compared. As shown, *Phaeodiscula tremae* from Formosa and Tokunoshima Island and *Capnodiastrum guaraniticum* sensu Katumoto and Harada from Chichijima Island comprised one group according to the sizes of pycnidia and conidia and were clearly separated from *C. guaraniticum* Speg. from Paraguay and *C. tremae* from Venezuela. From these results, three East-Asian materials seem to be the same species in the genus *Capnodiastrum*, and a new specific epithet *sawadae* is given for them as *C. sawadae* Tak. Kobay. & Ky. Watan., because *C. tremae* (Syd.) Petr. 1952 has authentic priority in this genus.

10. *Nyssopsora formosana* (Sawada) Lütjeh., Blumea Suupl. I (29), 6:160, 1937; Ito, Mycol. Flora of Japan II (3): 50, 1950; Sawada, Spec. Bull. Coll. Agr., Natn. Taiwan Univ. 8: 84, 1959

Figs. 2e–g, 4a–d

Synonym: *Triphragmium formosana* Sawada, Rept. Cent. Inst. Dept. Agr., Taiwan Gov. 51: 52, Pl. II: 38–40, 1931; Hiratsuka & Hashioka, Bot. Mag.(Tokyo) 48(568): 236, 1934; Hiratsuka, J. Jpn. Bot. 13(4): 250, Fig. 2, 1937.

Symptom and morphology (see Figs. 2e–g, 4a–d): After the new leaves sprout, yellow and powdery uredinia are formed densely on the lower leaf surface. Upper leaf surface becomes yellowish due to the formation of numerous yellow dots. Then, uredinia gradually disappear and alter to a telial state, with black masses of teliospores. Uredinia are

Fig. 2 a–d *Capnodiastrum sawadae* on *Tremaorientalis*. **a** Black sooty mycelial colonies developed on the lower leaf surface. **b** Closed pycnidia and conidia. **c** Matured disc-like pycnidia and conidia. **d** Conidia (phase contrasted). Bars **b**, **c** 50 μm ; **d** 15 μm . **e–g** *Nyssopsora formosana* on *Koelreuteria formosana*. **e** Densely formed yellowish uredinia on the lower leaf surface. **f** Densely formed black dots of telia on the lower leaf surface. **g** Telium and teliospores. Bar **g** 100 μm . **h, i** *Pestalotiopsis fici* on *Ardisia quinquegona*. **h** Brown spots surrounded by dark brown border. **i** Conidia having knobbed appendages at the tip (phase contrasted). Bar **i** 10 μm . **j–m** *Pseudocercospora acaciae-confusae* on *Acacia confusa*. **j** Diseased leaf showing both the dark brown spot and leaf blight lesion on the upper leaf surface. **k** Leaf blight lesions on the lower leaf surface. **l** Stroma and conidiophores. **m** Conidium (phase contrasted). Bars **l** 10 μm ; **m** 15 μm

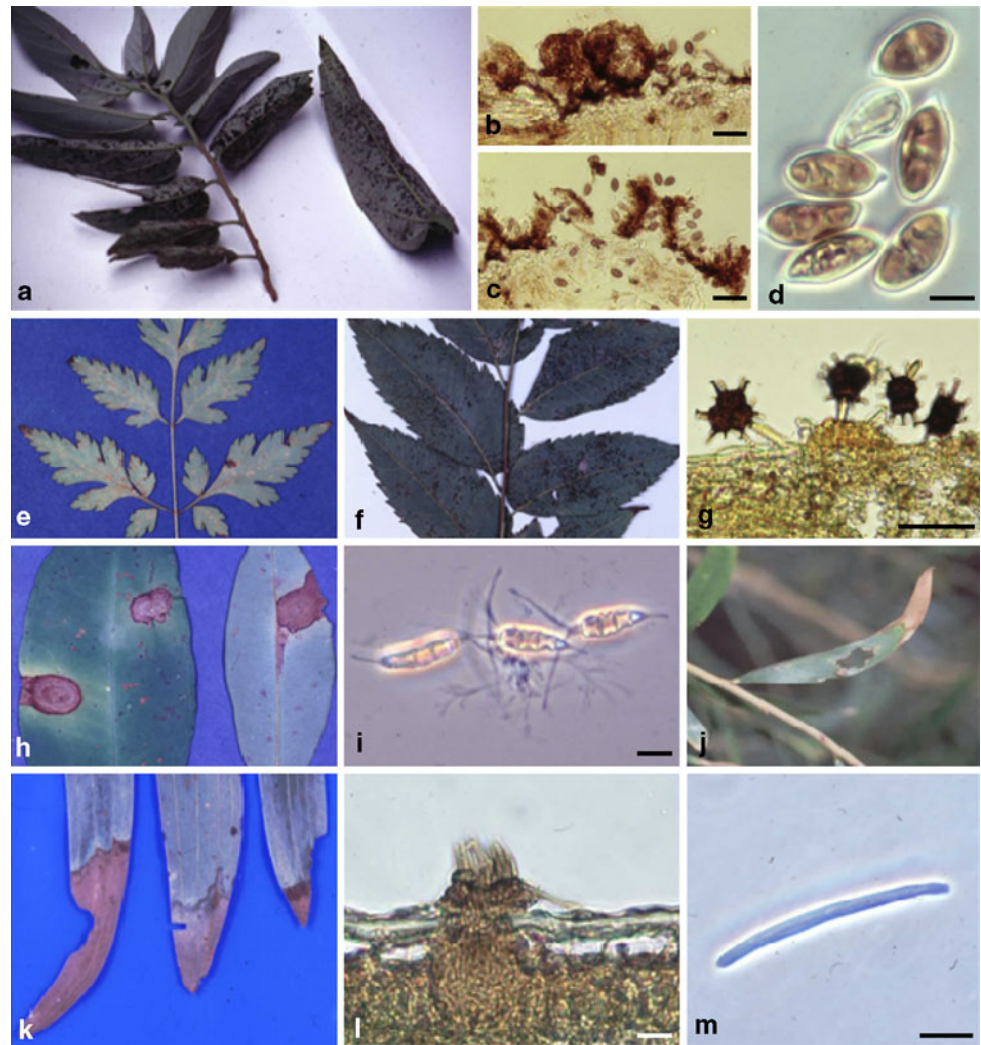


Table 1 Comparison of the taxonomic data among species of the genus *Capnodiastrum* parasitic to ulmaceous plants

Species	Pycnidium Diameter \times height (μm)	Conidium Length \times width (μm)	Host and locality	Literature	Symbol and number in Fig. 3
<i>Capnodiastrum</i> sp. from Tokunoshima Island	100–125 \times 105–113	27.5–35 \times 14–17.5 (av. 31.0 \times 15.3)	<i>Trema orientalis</i> Kyushu, Japan	This paper	● 1
<i>Phaeodiscula tremae</i> Sawada	57–104 \times 57–104	21–32 \times 13–18	<i>T. orientalis</i> Formosa	Sawada (1944)	● 2
<i>C. guaraniticum</i> sensu Katum. & Y. Harada	65–100	22.5–32 \times 12.5–17	<i>T. orientalis</i> Bonin Island, Japan	Katumoto and Harada (1979)	● 3
<i>C. guaraniticum</i> Speg.	50–60	16–18 \times 9–11	<i>Celtis boliviensis</i> Paraguay	Spegazzini (1886)	○ 2
<i>C. paraguayense</i> Speg. ^a	70–80	14–16 \times 7–8	<i>Celtis</i> sp. Paraguay	Spegazzini (1886)	○ 1
<i>C. tremae</i> Petr.	40–100	12–23 \times 8–12.5	<i>T. micranthae</i> Venezuela	Sydow (1930)	● 4

^a Sutton (1980) treated this species as a synonym of *C. guaraniticum*

mostly hypophyllous, immersed at first, then break through the epiderm, widely open like acervulus, and expose the masses of urediniospores, 80–160 μm in diameter.

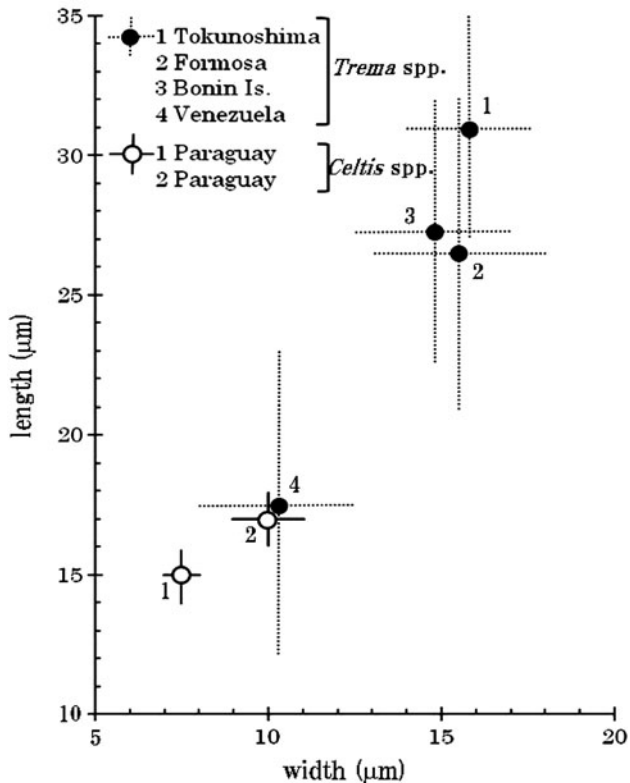
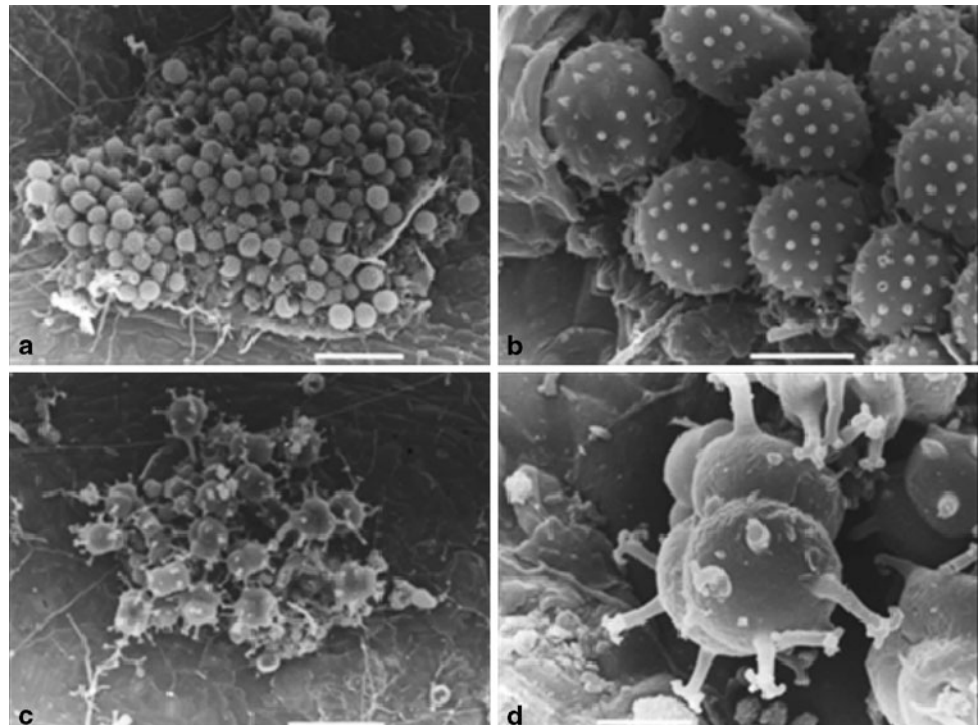


Fig. 3 Sizes of conidia of *Capnodiastrum* species on ulmaceous plants

Fig. 4 *Nyssopsora formosana* on *Koelreuteriaformosana*. **a** Uredinia dispersing urediniospores. **b** Urediniospores ornamented with many spicules. **c** Telia and teliospores. **d** Teliospores ornamented with anchor-like projections. (Scanning electron micrograph. Bars a 20 μm ; b 10 μm , c 50 μm , d 15 μm)



Urediniospores are subglobular to broadly elliptic, hyaline to pale yellow, 14–18 μm in diameter, covered with a thin cell wall set by minute numerous thorns. Telia are mostly hypophyllous, immersed at first, then break through the epiderm, 75–150 μm in diameter. Teliospores are composed of 3 cells, trigonal-subglobose, 25–30 \times 25–32.5 μm (27.4 \times 27.4 μm on average), dark brown to dark olive, with hyaline to pale pedicels 12–30 μm long, and ornamented with anchor-like projections, 9–15 per spore, 12–30 μm long, and mostly 2–4 branches at its tip.

Disease name: Sabi-byo in Japanese (Sawada 1931), Rust.

Specimen examined: On living leaves of *Koelreuteria formosana* Hayata (Taiwan-mokugenji in Japanese), Japan: Southeast Bot. Gard., Okinawa-city, Okinawa-Honto, Okinawa Prefecture, November 7, 1994, by TK (TFM: FPH-8056); November 11, 1995, by TK (TFM: FPH-8081). Formosa: Taipei, Nov. 1, 1928, by Kaneyoshi Sawada (KS), as *Triphragmium formosanum* Sawada (Herb. Hiratsuka 101943); Taipei, December 9, 1933, by Yoshio Hashioka (YH), as *Triphragmium formosanum* Sawada (Herb. Hiratsuka 101945); Taipei, January 8, 1933, by YH, *Triphragmium formosanum* Sawada (Herb. Hiratsuka 101948).

Taxonomic note: The rust fungus was observed and collected at the Southeast Botanical Gardens, Okinawa Main Island, in 1994 and 1995. On the lower surface of the diseased leaves, yellowish uredinia and blackish telia were densely formed. From the unique morphological characteristics of teliospores with anchor-like projections on their

Table 2 Comparison of taxonomic data among the species of *Nyssopsora* recorded on *Koelreuteria*

Species	Urediniospore Length × width (μm)	Teliospore Length × width (μm)	Pedicel Length (μm)	Projection no. and Length	Host and locality	Literature
<i>Nyssopsora</i> sp. from Okinawa	14–18 (av. 15.5)	25–30 × 25–33 (av. 27 × 27)	12–30 (av. 18.5)	9–15 7.5–15	<i>K. formosana</i> Okinawa, Japan	This paper
<i>Triphragmium formosanum</i> Sawada	17–21 × 16–19 (av. 19 × 17.5)	26–28 × 27–29 (av. 27 × 28)	18–32 (av. 25)	11–15 9–16	<i>K. formosana</i> Formosa	Sawada (1931, 1959)
	17–23 × 16–20 (av. 20 × 18)	26–32 × 27–31 (av. 29 × 29)	–42	11–17 –	<i>K. formosana</i> Formosa	Hiratsuka (1937)
<i>Nyssopsora formosanum</i> (Sawada) Lütjeh.	16–23 × 14–20 (av. 19.5 × 17)	25–32 × 27–32 (av. 28.5 × 29)	–42	11–17 9–16	<i>K. formosana</i> Formosa	Ito (1950)
<i>Nyssopsora koelreuteriae</i> (Syd. & P. Syd.) Tranzschel	17–26 × 15–18 (av. 21.5 × 21.5)	26–34 × 24–28 (av. 30 × 26)	–	10–20 ~9	<i>K. paniculata</i> Honshu, Japan	Ito (1950)
	18–35 × 14–25 (26.5 × 19.5)	30–40 × 28–39 (35 × 33.5)	~52	18–30 ~9	<i>K. paniculata</i> Honshu, Japan	Hiratsuka et al. (1992)

surfaces, this rust fungus belongs to the genus *Nyssopsora*. On *Koelreuteria* plants, two *Nyssopsora* species have been known. One is *Nyssopsora koelreuteriae* (Syd.) Tranzschel and the other is *N. formosana* (Sawada) Lütjeh. In Table 2, morphology of the rust collected from Okinawa is compared with those of two *Nyssopsora* species hitherto known. Sizes of urediniospore and teliospore, length of pedicel of teliospore, number and length of projection on teliospore in the rust from Okinawa were well accorded with those of *N. formosana*, but not with those of *N. koelreuteriae*. Urediniospores and teliospores of the rust fungus were smaller than those of *N. koelreuteriae*. Pedicels of teliospore in the former are shorter than those of the latter. Teliospores of the former have a smaller number of projections than those of the latter. Conversely, the projections in the former fungus are longer than those of the latter. From these facts, the fungus was identified as *N. formosana*. This is the first record of this fungus from Japan.

11. *Pestalotiopsis fici* Steyaert, Bull. Jard. Bot. Brux. 19(3): 324, 1949; Kobayashi et al. Forest Pests 58 (2): 59, 2009 Figs. 2h–i, 5

Synonym: *Pestalotia fici* (Steyaert) Guba, Monograph of *Monochaetia* and *Pestalotia*, 91, 1961.

Symptom and morphology (see Figs. 2h–i, 5): Leaf spots are pale brown to brown, subcircular, 5–15 mm in diameter, surrounded by dark brown zone. Minute black dots (acervuli) scattered on the leaf spot. Acervuli are immersed within epidermal cell layer, then break through it mature. Conidia are oblong to fusoid, 5-celled by 4 transverse septa, 20–25 × 5–7 μm , with both hyaline end cells. Three intermedial cells are pale brown and 14–17.5 μm in length. Appendages are (2) 3 on the top of the upper end

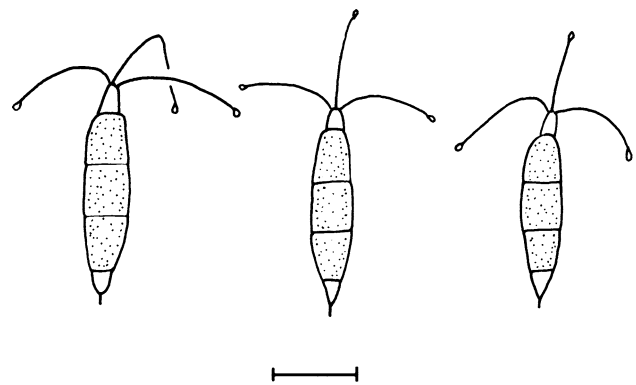


Fig. 5 Conidia of *Pestalotiopsis fici* having knobbed appendage. Bar 10 μm

cell, 17.5–22.5 μm in length, and swell as a small ball at their tip. One basal appendage is 1.3–7.5 μm in length.

Disease name: Pestalotia-byo in Japanese (Kobayashi et al. 2009), Pestalotia disease.

Specimen examined: On living leaves of *Ardisia quinquegona* Blume (Shishiakuchi, in Japanese), Minami-meijiyama, Nago, Okinawa Prefecture (Okinawa Island), November 10, 1994, by TK & Choei Ogimi (TFM:FPH-8047).

Taxonomic note: This fungus has the unique feature that the conidia have appendages with a swollen ball-like structure at their tip. In the genus *Pestalotiopsis* (*Pestalotia*), 15 species have been known as having knobbed appendage (Guba 1961). Among them, 5 species are apparently different from the fungus on *Ardisia*, in their median colored cells composed of two upper brown to dark brown cells and one lower pale brown cell. Seven of 10 remaining species also differ from *Pestalotiopsis* in their

large conidia and long apical appendages. Among the remaining 3 species, *Pestalotiopsis javanica* (Guba) Y. X. Chen (Guba 1961) is clearly distinguishable from this fungus by its small and strongly constricted conidia, long apical appendages, and quite long filamentous basal appendages, as shown in Table 3. *Pestalotiopsis phoenicis* (Vize) Y. X. Chen (Guba 1961) is also different from this fungus in its small conidia and darker colored intermediate cells (Table 3). Morphological characteristics of the fungus described here on *Ardisia* well accorded with those of *Pestalotiopsis fici* Steyaert (1949) originally described on *Ficus* sp. from Uganda and then on *Cocos nucifera* from Sierra Leone (Guba 1961). This is the first record of this fungus species in Japan, and *Ardisia quinquegona* is a new host of the fungus. In Japan, another *Pestalotiopsis* species, *P. theae* (Sawada) Steyaert on several broad-leaved trees (Kobayashi 2007) is well known as having similar unique appendages.

12. *Pseudocercospora acaciae-confusae* (Sawada) Goh & W. H. Hsieh, Trans. Mycol. Soc. R.O.C. 4(2): 41, 1989; Hsieh & Goh, *Cercospora* and similar fungi from Taiwan: 176, 1990; Guo & Hsieh, The genus *Pseudocercospora* in China: 36, 1995; Crous & Braun: *Mycosphaerella* and its anamorph I: 39, 2003; Kobayashi et al., Forest Pests 56(5): 24, 2007 Figs. 2j–m; 6

Basionym: *Cercospora acaciae-confusae* Sawada, Rep. Gov. Agr. Res. Inst. Taiwan 35: 105, 1928.

Synonym: *Pseudocercospora acaciae-confusae* (Sawada) Y.L.Guo & X.J. Liu, Mycosystema 2: 226, 1989. Later homonym of *Pseudocercospora acaciae-confusae* (Sawada) Goh & Hsieh.

Symptom and morphology (see Figs. 2j–m, 6): From the tip of leaves brown blight lesions extend downward. Fruiting bodies are mainly produced on the upper surface of the lesions as minute black masses of stroma, which are first immersed within the epidermal layer then erumpent, 17–34 μm in diameter and pale brown to pale olive in color. Conidiophores are 5–10 in number, loosely fascicled on the surface of the stroma, usually 1-septate, pale olive brown, 12–30 \times 2.5–3 μm , with thin conidial scars. Conidia are long, cylindric, straight or curved, obtuse at the apex, with truncate and thin basal end, pale brown to pale olivaceous, 2–5-septate, 36–61 \times 3–4.5 μm (54.5 \times 3.6 μm in average), smooth. Numerous conidia were produced when the pieces of mycelial colonies were placed on a potato dextrose agar (PDA) plate at 25°C after they were stored for 1 month in liquid nitrogen. These conidia were long, cylindric, straight or curved, hyaline to very pale olivaceous, 3–7-septated, 43–82 \times 2.4–4.5 μm (59.1 \times 3.4 μm on average), smooth.

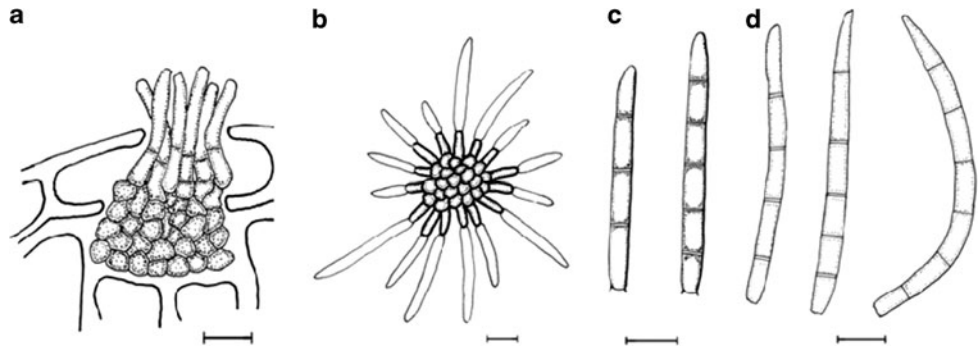
Disease name: Maruhoshihyo in Japanese (Sawada 1928), Circular leaf spot.

Table 3 Comparison of morphological characteristics in *Pestalotiopsis* spp. having the same type of intermediate-colored cells and knobbed appendage

Species	Conidium		Intermediate cells		Appendage		Host and distribution	Literature
	Length \times width (μm) (l/b)		Length (μm)	Color	Apical	Basal		
	Length \times width (μm)		Length (μm)		Number	Length (μm)		
<i>Pestalotiopsis</i> sp.	20–25 \times 5–7 (av. 23.1 \times 5.9) (3.9)		13.8–17.5 (av. 15.6)	Pale brown	(2–)3	17.5–22.5 (av. 19.6)	1.3–7.5	<i>Ardisia quinquegona</i> , Japan This paper
<i>P. fici</i>	22–28 \times 5–6.5 (4.3)		14–19	Pale brown	(2–)3(–4)	5–19	2–6	<i>Ficus</i> sp., Uganda Steyaert (1949)
<i>P. javanica</i>	19–26 \times 5–7 (3.8)		14–19	Pale brown	(2–)3(–4)	9–20 (av. 14.5)	2–6	<i>Cocos nucifera</i> , Sierra Leone Guba (1961)
<i>P. phoenicis</i>	16–18 \times 5–6.5 (3.0) ^a		–	Dark Strongly constricted	2–3	30–32 (av. 31)	60–75	<i>Myrica javanica</i> , Indonesia Guba (1961)
	16–22 \times 5–7 (3.2) ^a		11–14 (av. 12.5)	Umber to olive	(2–)3(–4)	(av. 22)	Short	<i>Phoenix dactylifera</i> East India Guba (1961)

^a Morphological characters are seemed to be different from those of *Pestalotiopsis* sp. of Okinawa Island

Fig. 6 *Pseudocercospora acaciae-confusae*. **a** Stroma and conidiophores. **b** Stroma, conidiophores and young conidia (overview). **c** Mature conidia on host. **d** Conidia produced on the colonies on a potato dextrose agar (PDA) plate at 25°C, after pieces of colony were stored for 1 month with liquid nitrogen. Bars, **a, c,** **d** 10 µm; **b** 15 µm



Specimen examined: On living leaves of *Acacia confusa* Merr. (Soushiju in Japanese), Round road of Mt. Ohyama, China-cho, Ohshima-gun, Kagoshima Prefecture (Okinoerabu Is.), November 20, 2001, by TK and Yasunori Ono (TFM: FPH-8083; Isolates: MAFF 239180).

Taxonomic note: Morphological characteristics of this fungus well accorded with those of *Pseudocercospora acaciae-confusae* (= *Cercospora acaciae-confusae*), which was described on the same host, *Acacia confusa* Merr., from Formosa and continental China (Sawada 1928; Hsieh and Goh 1990; Guo and Hsieh 1995). In Formosa and China, the fungus forms circular to somewhat angular leaf spots. However, in Okinoerabu Island of Japan, the fungus mainly causes leaf blight lesions from the tip of leaves, except for a small number of the typical spot. On this island, the host plant is exposed strong winds; those in Formosa and China may exist in a different environment. This is the first record of this fungus from Japan. According to Crous and Braun (2003), the species has been collected from Hong Kong and Libya on *Acacia* sp.

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