

FULL PAPER

Takao Kobayashi · Chiharu Nakashima
Takuya Nishijima

Notes on some plant-inhabiting fungi collected from the Nansei Islands (1)

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Abstract In the course of a survey on plant diseases and their pathogenic fungi in the Nansei Islands, some noteworthy fungi were collected. Among them, four fungi newly found in Japan were described with some mycological and pathological notes. These species are *Septoria gardeniae* Savelli, causing circular leaf spot of *Gardenia*; *Phyllosticta cordylinophila* Young apud Stevens, causing brown leaf spot of *Cordyline*; *Phyllosticta drummondii* Vanef et van der Aa, causing brown needle blight of *Araucaria*; and *Phyllachora minuta* Hennings, causing tar spot of *Hibiscus*.

Key words Nansei Islands · New to Japan · Plant-inhabiting fungi

Introduction

Since 1988, the flora of plant parasitic fungi in the Nansei Islands have been surveyed by the senior author and his collaborators. Preliminary results of these studies in some Islands have been reported (Kobayashi 1996; Kobayashi and Kawabe 1991; Kobayashi and Nishijima 1995; Kobayashi and Watanabe 1995; Kobayashi et al. 1990, 1994, 1998, 2001). Among the collected fungi, those belonging to the genus *Cercospora* and related genera were reported in succession in the other series (e.g., Kobayashi et al. 1998; Nakashima et al. 2002). For the other fungi, including new

species and newly recorded species in Japan, a new series of articles is begun here. In this first paper, four fungi newly identified were selected, and we describe their morphological characteristics with some mycological and pathological notes. All these taxa were first introduced in Japan (Kobayashi 1996; Kobayashi and Nishijima 1995; Kobayashi and Watanabe 1995; Kobayashi et al. 2001).

Descriptions

1. *Septoria gardeniae* Savelli causing circular leaf spot of *Gardenia*

Ann. Acad. Agr. Torino 57: 80, 1915; Trotter et al., Saccardo's Syll. Fung. 25: 448, 1931; Kobayashi and Nishijima, Ann. Phytopath. Soc. Japan 61: 222, 1995.

Synonym: *Septoria gardeniae* Patil, Sukapure et Thirumalachar, Sydowia 20: 179, 1966

Symptom and morphology (see Figs. 3, 9, 10): Leaf spots are circular, pale brown to grayish-brown with brown border, 10–20 mm in diameter, and black pinpoints of pycnidia are densely produced on the lower surface of the spot. Later, these points are also produced on the upper surface. Diseased leaves having two or three spots turn to yellow and gradually defoliate. Pycnidia are hypophyllous at first, then become amphigenous, immersed within epidermal layer and spongy cell tissue, black, globular, 40–100 µm in diameter, filled with numerous hyaline conidia. Pycnidial wall is composed of irregular, dark, and thick-walled cells (textura porrecta), 5–15 µm in thickness. Conidiogenous cells develop from inner hyaline tissue of pycnidial wall and produce conidia phialidically. Conidia are hyaline, cylindrical, often curved irregularly, 1–3-septate, smooth, 15–30 × 2–3 µm (22.1 × 2.3 µm in average).

Disease name: Circular leaf spot (Ura-kokuten-maruhoshi-byo, in Japanese).

Specimen examined: *Gardenia jasminoides* Ellis (Japanese name, Kuchinashi): Ban'na Park, Ishigaki, Okinawa Pref. (Ishigaki Is.), March 7, 1994, by Takao Kobayashi (TK) (TFM: FPH-6466) (Isolate: MAFF-237041); Nashiro,

T. Kobayashi (✉)
Department of International Agricultural Development, Tokyo
University of Agriculture, Setagaya-ku, Tokyo 156-8502, Japan
Tel. +81-3-5477-2410; Fax +81-3-5477-4072
e-mail: takob@ontf.biglobe.ne.jp

C. Nakashima
Biotechnology Development Center (NBDC), National Institute of
Technology and Evaluation, Kisarazu, Chiba, Japan

T. Nishijima
Shizuoka Tea Experiment Station, Kurasawa, Kikugawa, Ogasa,
Shizuoka, Japan

Itoman, Okinawa Is., Okinawa Pref. Nov. 12, 1994, by TK (TFM: FPH-6467) (Isolate: MAFF-237191).

Taxonomic note: On *Gardenia* plants, two species of *Septoria* have been described, namely *S. gardeniae* Savelli (in Trotter et al. 1931, from Italy on *Gardenia* sp.) and its later homonym *S. gardeniae* Patil et al. (1966, from India on *G. gummifera*). Morphological characteristics of the latter species are identical with those of the former species. Those of the *Septoria* collected from Ishigaki Is. are also identical with those of *S. gardeniae* Savelli. Therefore, the present *Septoria* was identified as *S. gardeniae* Savelli, and *S. gardeniae* Patil et al. was treated as a synonym of *S. gardeniae* Savelli. No other record of this species has been found. In Japan each of the diseased materials of *G. jasminoides* caused by *S. gardeniae* Savelli were collected from Okinawa Is. and Ishigaki Is., respectively, as listed above (Kobayashi and Nishijima 1995).

Pathogenicity (see Fig. 4): Monoconidial isolate of the fungus (MAFF-237041) developed black irregular colonies producing many black pycnidia on potato dextrose agar (PDA) slants. An inoculum suspension containing conidia and mycelia, which was made by maceration of colonies, was sprayed onto healthy leaves of *Gardenia* cuttings with or without wounds (August 1, 1994). A polyethylene bag was used to cover each inoculated plant. Inoculated plants were kept under laboratory conditions at 23°C, and polyethylene bags were removed after 2 days. After 2 weeks from the inoculation, pale brown leaf spots developed around all pinhole wounds on all inoculated leaves. Many black pycnidia were produced on the central part of spots. Besides these, one spot developed on each of two leaves inoculated without any wounds, and pycnidia matured on these spots. Another inoculation test was carried out by placing a piece of colony on each wounded or unwounded part of leaves (August 1, 1994). Clear leaf spots developed around the pinhole wounds after 10 days from inoculation, but no spot developed from the inoculum pieces placed on the nonwounded healthy part. Pycnidia were also produced on the central part of spots.

2. *Phyllosticta cordylinophila* Young apud Stevens causing brown leaf spot of *Cordyline*

In Stevens, Bernice Bishop Mus. Bull. 19: 133, 1925; Trotter & Cash, Saccardo's Syll. Fung. 26: 969, 1972; Kobayashi et al. For. Pests 50(6): 134, 2001.

Synonym: *Phyllostictina cordylinae* (Thümen) Petrak et Sydow, die Gatt. Pyrenom. Sphaerops. und Melancon. I: 194, 1927.

Sphaeropsis cordylinae Thümen, Rev. Sci. Litter. Coimbra 28: 36, 1881.

Symptom and morphology (see Figs. 5, 11, 12): Leaf spots are brown and circular at first, then enlarge to 10–30 mm in diameter, become longitudinal eyelike spots, with reddish-brown border and grayish-brown center, and scattered small black pycnidia. Pycnidia are immersed, then erumpent, breaking through epidermis, globular, 100–140 µm in diameter, 60–110 µm in height. The pycnidial wall is 12–15 µm in thickness and composed of black, irregular, thick-walled cells. Conidiogeous cells form the innermost

layer of pycnidial wall and are hyaline and ampuliform. Conidia are hyaline, unicellular, ovoid to ellipsoid, 7–12.5 × 5–7.5 µm, filled with many granules, surrounded by thin sticky film, and furnished with a sticky appendage at the tip. Appendages are usually 5–10 µm long, sometimes 20–30 µm long.

Disease name: Brown leaf spot (Kappan-byo in Japanese).

Specimen examined: Leaves of *Cordyline terminalis* L. (Japanese name: Sen'nenboku): Kuba Nursery, Tatsugo, Oshima-gun, Kagoshima Pref. (Amami-ohshima Is.), June 9, 1992, by TK (TFM: FPH-6724); Tatsugo Branch, Kagoshima For. Exp. Sta., Tatsugo, Oshima-gun, Kagoshima Pref. (Amami-ohshima Is.), June, 9, 1992, by TK (TFM: FPH-6725); Sept. 9, 1996, by TK and Chiharu Nakashima (CN) (TFM: FPH-6729); Yoza, Itoman, Okinawa Pref. (Okinawa Is.), Nov. 12, 1994, by TK; Sept. 12, 1995, by TK and Yukio Yaguchi (YY) (TFM: FPH-6726); Tomigusuku, Shimajiri, Okinawa Pref. (Okinawa Is.), Sept. 12, 1995, by TK and YY (TFM: FPH-6727). *Cordyline atropurpurea* (Japanese name: Murasaki-atsubasen'nenboku): Himeyuri Park, Itoman, Okinawa Pref. (Okinawa Is.), Feb. 6, 1990, TK and Choei Ogimi (TFM: FPH-6728).

Taxonomic note: On *Cordyline* plants, four species of the genus *Phyllosticta* and one species of the genus *Phyllostictina* have hitherto been described. Among them, *Phyllosticta cordylinae* Saccardo et Berlese (1885, in Saccardo 1892), *P. draconis* Berkeley ex Cooke (1891, in Saccardo and Trotter 1913), and *P. cordylinae* Chowdhury (1970, the later homonym of *P. cordylinae* Sacc. et Berl.) are quite different from the Japanese fungus by their markedly smaller conidia. They belong to the genus *Asteromella* or *Phoma* (van der Aa and Vanef 2002). *Phyllosticta draconis* Berkeley ex Karsten (1896) has large conidia and is transferred to the genus *Macrophoma* as *M. draconis* (Berkeley ex Karsten) Allescher (van der Aa and Vanef 2002). The shape and color of spots and morphology of the fungus in Japanese materials accorded well with those of *Phyllosticta cordylinophila* Young apud Stevens (in Stevens 1925) and of *Phyllostictina cordylinae* (Thümen) Petrak et Sydow (1927). In recent mycological concepts, *Phyllostictina cordylinae* should be transferred to the genus *Phyllosticta* (van der Aa 1963; van der Aa and Vanef 2002). However, the specific epithet of *cordylinae* suggested by Thümen is not acceptable because of the earlier presence of *cordylinae* by Saccardo et Berlese in the genus *Phyllosticta*. Hence, *Phyllosticta cordylinophila* Young apud Stevens is used for the fungus in question. The other three species of *Phyllosticta* described hitherto on the related host genera *Dracaena* spp., namely *P. dracaenae* Hennings (1908, in Saccardo and Trotter 1913), *P. dracaenae* Griffon et Maublanc (1909, the later homonym of the former, in Saccardo and Trotter 1913), and *P. maculicola* Halsted (1894, in Saccardo and Trotter 1913), are distinctly different from the present fungus by their much smaller conidia. They belong to the genus *Phoma* or the spermogonium state of unknown Ascomycetes (van der Aa and Vanef 2002). Although *Phyllosticta dracaenicola* Chowdhury et al.

(1982) described on *Dracaena marginata* has conidia somewhat similar in size ($7\text{--}10 \times 4\text{--}5.5\mu\text{m}$) to those of *P. cordylinophila* Young apud Stevens, it was recognized as an independent species apart from *P. cordylinophila* in the monograph of the genus *Phyllosticta* by van der Aa and Vanef (2002). We followed their treatment. The present species has been recorded on *Cordyline terminalis* from Hawaii (Raabe et al. 1981; Stevens 1925), New Zealand (McKenzie et al. 1992; Pennycook 1989), Tonga (Dingley et al. 1981), Western Samoa (Dingley et al. 1981), and Japan (Kobayashi et al. 2001).

3. *Phyllosticta drummondii* Vanef et van der Aa causing brown needle blight of *Araucaria heterophylla*

van der Aa and Vanef, Rev. species in *Phyllosticta*: 28, 2002.

Synonym: *Phyllosticta brasiliensis* Linder (1943, non-Spegazzini 1889), Mycologia 35: 497, 1943; Kobayashi and de Guzman, Bull. For. For. Prod. Res. Inst. 351: 170, 1988; Kobayashi and Watanabe, Abst. 39th Annu. Meet. Mycol. Soc. Jpn. 52, 1995.

Phyllosticta acicola Bissett et Palm, Can. J. Bot. 67: 3389, 1989.

Symptom and morphology (see Figs. 1, 6, 7, 13, 14): Tip of young twig or shoot, 3 to 8 cm in length, becomes brown, and minute black pinpoint of pycnidia are produced on dead needles. Pycnidia are immersed at first, then erumpent, breaking through the epidermal layer, black, globular, $100\text{--}130\mu\text{m}$ in diameter, $90\text{--}120\mu\text{m}$ in height. Wall of perithecia is composed of irregular and thick-walled cells, dark brown to blackish in color, $10\text{--}20\mu\text{m}$ in thickness. Conidiogenerous cells are ampuliform, lining hyaline and innermost layer of perithecial wall. Conidia are ovoid to broad elliptical, hyaline, $9.5\text{--}12 \times 7\text{--}9\mu\text{m}$, with one sticky appendage at the top, $2.4\text{--}3.6\mu\text{m}$ in length.

Disease name: Brown needle blight (Kasshoku-hagarebyo in Japanese).

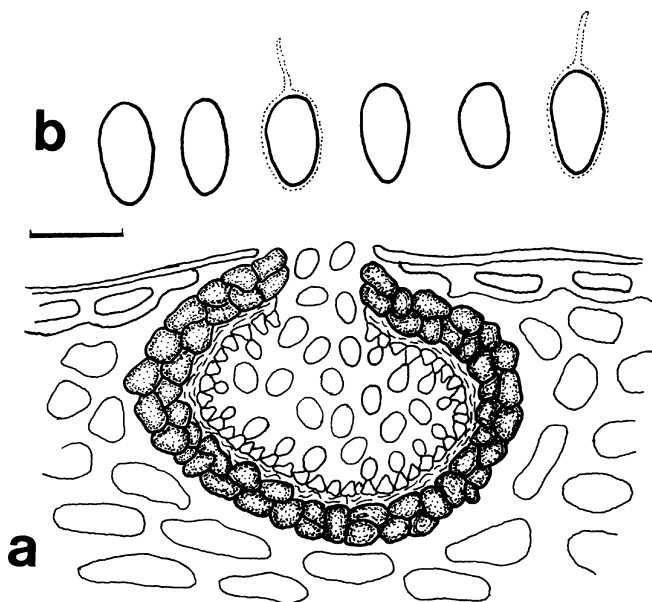


Fig. 1. *Phyllosticta drummondii*. a Pycnidium. b Conidia. Bar $20\mu\text{m}$

Specimen examined: Needles of *Araucaria heterophylla* (Salish) Franco (Japanese name, Kobano-nanyosugi): Shimashi, Ginowan, Okinawa Pref. (Okinawa Is.), Feb. 6, 1990, by TK; Parapido Fruit Garden, Ishigaki, Okinawa Pref. (Ishigaki Is.), Nov. 30, 1988, by TK and Masatoshi Onuki; Okinawa Branch, Trop. Agr. Res. Cent., Maesato, Ishigaki, Okinawa Pref. (Ishigaki Is.), Dec. 8, 1992, by TK.

Taxonomic note: Kobayashi and de Guzman (1988) recorded *Phyllosticta brasiliensis* Linder (1943 non-Spegazzini 1889, Brazil) causing needle blight of *Araucaria heterophylla* from the Philippines. Morphological characteristics of Japanese materials collected at Okinawa and Ishigaki Islands accorded well with those of *P. brasiliensis* Linder from the Philippines. The other two species described on *Araucaria*, namely *Phyllosticta araucariae* Woronichin (1913 non-Saccardo 1915, in Trotter et al. 1931) and *P. araucariicola* Trotter (in Trotter et al. 1931, *P. araucariae* Sacc.), are distinctly different from *P. brasiliensis* Linder by their quite small conidia ($3 \times 2\mu\text{m}$ and $4.5 \times 2\mu\text{m}$, respectively). Because *Phyllosticta brasiliensis* Spegazzini (1889, in Saccardo and Trotter 1913) on *Zanthoxylon* from Brazil has nomenclatural priority against *P. brasiliensis* Linder (1943), van der Aa and Vanef (2002) gave a new specific epithet, *drummondii*, for *P. brasiliensis* Linder. Moreover, they treated *Phyllosticta acicola* Bissett et Palm (1989) as a synonym of *P. drummondii*. We accepted their treatment and altered the species name of *Araucaria* needle blight fungus to *P. drummondii* from *P. brasiliensis*. This species has been reported from Brazil, Canada, Japan, and Philippines (Bissett and Palm 1989; Kobayashi and de Guzman 1988; Kobayashi and Watanabe 1995; Linder 1943).

4. *Phyllachora minuta* Hennings causing tar spot of *Hibiscus tiliaceus*

Hedwigia 41: 143, 1902; Saccardo and Sydow, Syll. Fung. 17: 832, 1905; Sawada, Descr. Catal. Formosan Fungi 8: 26, 1943; Kobayashi, For. Pests 45(1): 9, 1996.

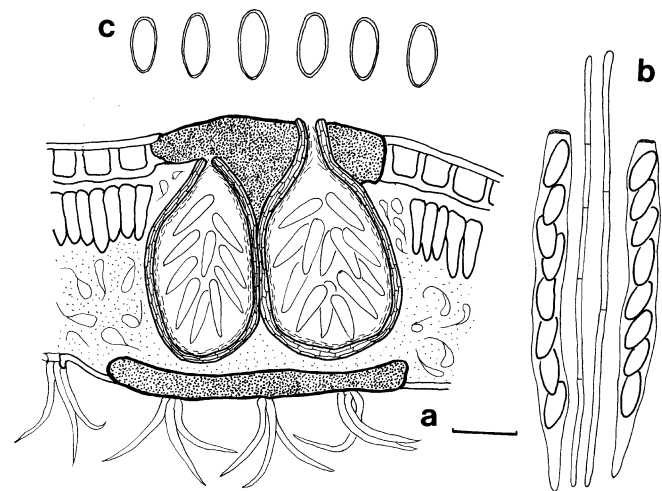


Fig. 2. *Phyllachora minuta*. a Ascoma. b Asci with ascospores and paraphysis. c Ascospores. Bar $20\mu\text{m}$

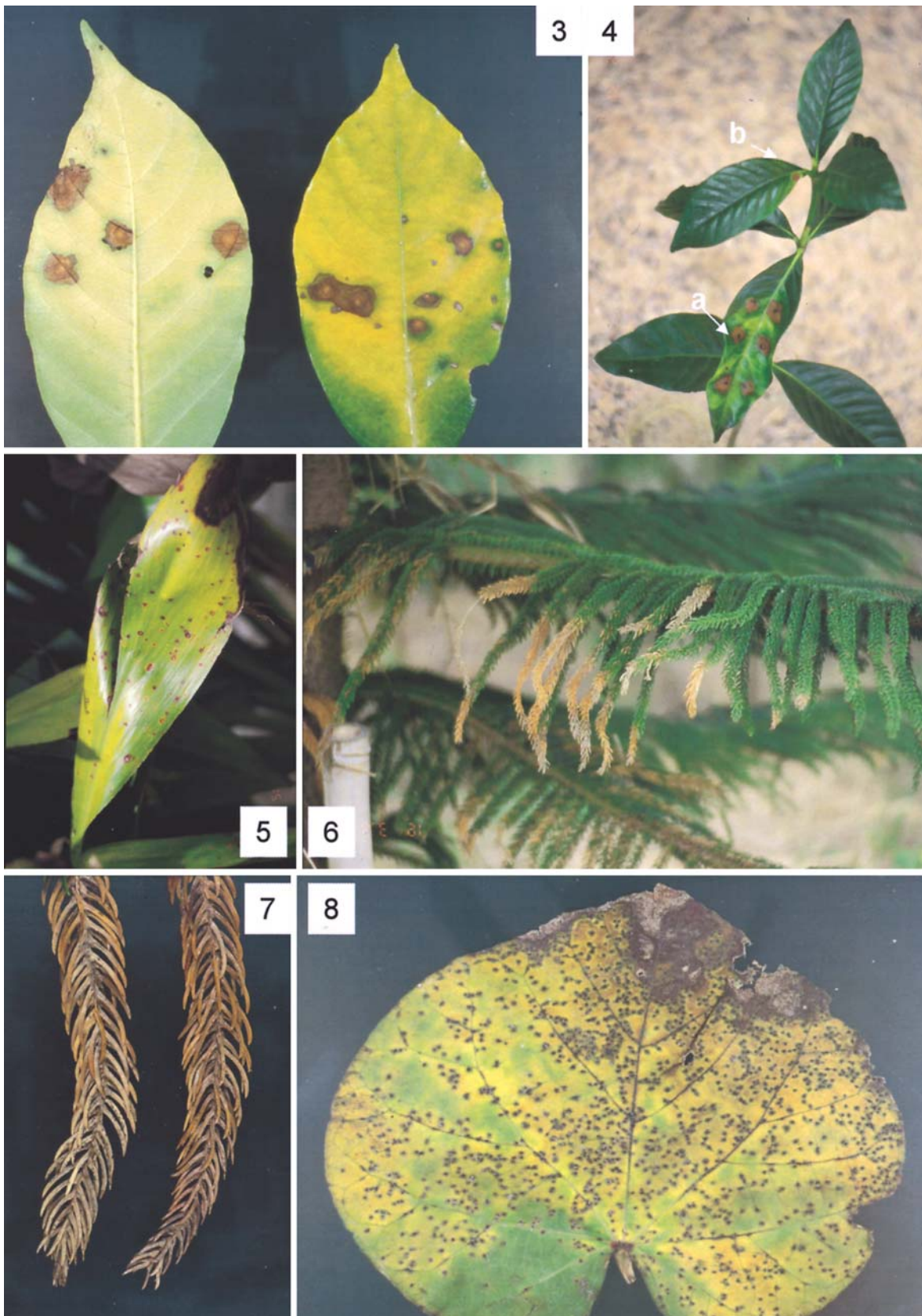


Fig. 3. Symptom of circular leaf spot of *Gardenia jasminoides* caused by *Septoria gardeniae*

Fig. 4. Results of inoculation test of *Septoria gardeniae* to *Gardenia jasminoides*; *a*, spots developed around the pinhole wounds 2 weeks after inoculation; *b*, without any wounds, only one spot developed

Fig. 5. Symptom of brown leaf spot of *Cordyline terminalis* caused by *Phyllosticta cordylinophila*

Fig. 6. Symptom of brown needle blight of *Araucaria heterophylla* caused by *Phyllosticta drummondii*

Fig. 7. Magnification of Fig. 6

Fig. 8. Symptom of tar spot of *Hibiscus tiliaceus* caused by *Phyllachora minuta*

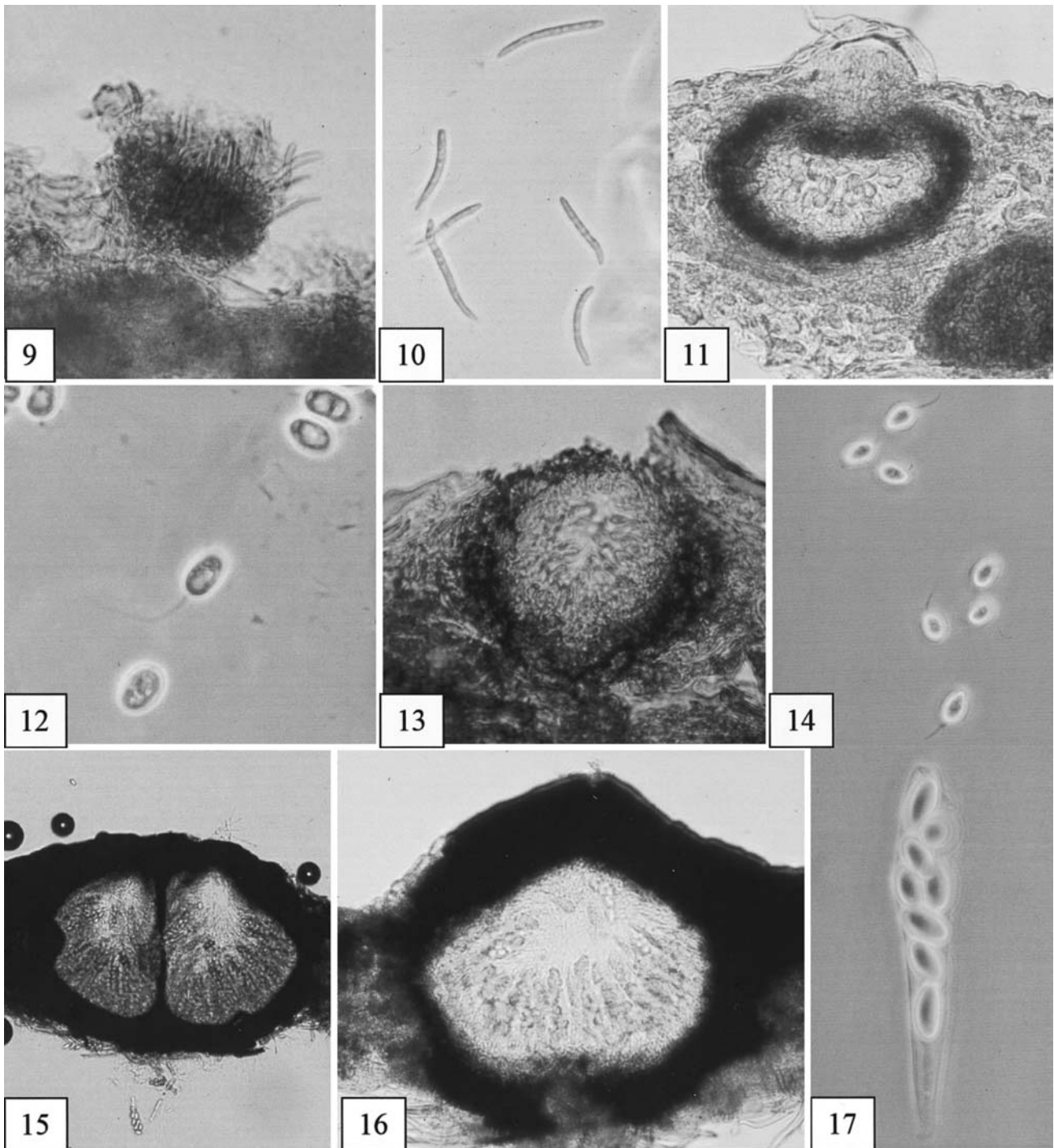


Fig. 9. Pycnidium of *Septoria gardeniae*

Fig. 10. Conidia of *Septoria gardeniae*

Fig. 11. Pycnidium of *Phyllosticta cordylinophila*

Fig. 12. Conidia of *Phyllosticta cordylinophila*

Fig. 13. Pycnidium of *Phyllosticta drummondii*

Fig. 14. Conidia of *Phyllosticta drummondii*

Fig. 15. Ascoma of *Phyllachora minuta*

Fig. 16. Magnification of Fig. 15

Fig. 17. Ascus with ascospores of *Phyllachora minuta*

Symptom and morphology (see Figs. 2, 8, 15, 16, 17): Small black dots (stromata of the fungus) are formed densely on green leaves. The surrounding area of these black dots gradually turns yellowish-orange to scarlet, and large grayish-brown leaf blight lesions are formed finally.

Then, diseased leaves successively defoliate. Perithecial stromata are black, 0.5–1 mm in diameter. Perithecia are immersed within stroma as locule-like chambers, one to several, 260–650 μm in diameter, 250–420 μm in height, with apical pore having periphyses. Perithecial wall is composed

of parallel mycelial layer, textura porrecta, almost hyaline, 30–50 µm in thickness. Asci are unitunicate, clavate with short stipe, not stained blue by iodine (J–), and contain 8 ascospores in one row or two irregular rows, 67–103 × 12–19 µm. Ascospores are one-celled, hyaline, elliptical to fusoid, somewhat thick-walled, 14.5–20 × 7.5–10 µm, smooth.

Disease name: Tar spot (Kuroyani-byo in Japanese).

Specimens examined: Leaves of *Hibiscus tiliaceus* L. (Japanese name, Oh-hamabo): Hateruma, Taketomi, Yaeyama, Okinawa Pref. (Hateruma Is.), March 16, 1994, by TK; Oura, Nago, Okinawa Pref. (Okinawa Is.), Nov. 9, 1994, by TK (TFM: FPH-6730); Chinen, Shimajiri, Okinawa Pref. (Okinawa Is.), Nov. 12, 1994, by TK (TFM: FPH-6731); Port Chabana, Yoron, Oshima, Kagoshima Pref. (Yoron Is.), Nov. 23, 2001, by TK and Yasunori Ono.

Taxonomic note: On *Hibiscus* plants, three species of *Phyllachora* have hitherto been described, namely *P. hibiscicola* (Schweinitz) Saccardo (1883, North America), *P. hibisci* Rehm (1897, in Saccardo and Sydow 1899, Brazil), and *P. minuta* Hennings (1902, in Saccardo and Sydow 1905, Indonesia). In the monograph on Dothideales by Theissen and Sydow (1915), the latter two species were accepted as independent species, respectively. *P. hibiscicola*, which had no record of fruiting bodies, was excluded from the genus *Phyllachora* and abandoned. *P. minuta* densely forms minute black stromata without leaf spots and 0.5–1 mm in size, whereas the stromata of *P. hibisci* are 2–4 mm in size and are surrounded by distinct grayish-brown spots. We collected two kinds of tar spot disease on *Hibiscus tiliaceus*. The five materials described above were identical with *P. minuta* and the other two with *P. hibisci*. In Japan, Katsuki (1956) listed *Phyllachora minuta* from Amami-oshima Is. without any mycological note, and Hino and Katamoto (1963) listed it in their fungal list of Ryukyu Archipelago, referring Katsuki. The present species has hitherto been recorded on *Hibiscus tiliaceus* from Asia outside Japan (India, Indonesia, Philippines, Taiwan), Oceania (Australia), Africa (South Africa), and South America (Puerto Rico, Venezuela) (Bilgrami et al. 1991; Boedijn 1940; Doidge 1950; Ramakrishnan and Sundaram 1955; Saccardo and Sydow 1905; Sawada 1943; Seaver and Chardon 1926; Semangun 1992; Stevenson 1975; Tai 1979; Teodoro 1937; Theissen and Sydow 1915; Tsai 1991).

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