

Five new foliicolous micromycete records from Turkey

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ABSTRACT—Among microfungi collected on foliar spots of vascular plants in Yedigöller National Park, Bolu Province, Turkey, five species represent new records for Turkey: *Ascochyta daturae*, *A. euonymi*, *Mycosphaerella laureolae*, *Phyllosticta datiscae*, and *Rhabdospora visci*. Detailed descriptions and photographs of these species are provided.

KEY WORDS—*Ascomycota*, biodiversity, new host, SEM, taxonomy

Introduction

Microfungi can cause various diseases through leaf infection. *Ascochyta* Lib., *Mycosphaerella* Johanson, *Phyllosticta* Pers., and *Rhabdospora* (Durieu & Mont.) Sacc. are among the genera that include species causing foliar spots. Some of these foliar-pathogenic fungi show host specificity, while others can be found on several hosts: e.g., *Rhabdospora visci* infects only *Viscum album*, while *Ascochyta daturae* is observed on more than one species in *Solanaceae*.

Foliar pathogens causing needle or leaf-bound diseases can cause growth reduction as a result of a decrease in photosynthetic capacity at high levels of infection (Van der Pas 1981, Manter & al. 2003, Hanso & Drenkhan 2012).

Tree mortality can be seen only in serious cases. By weakening the tree, leaf diseases can contribute to higher sensitivity to biotic and abiotic stresses (Bednářová & al. 2013, Kowalski 2013). Based upon trophic interactions with the host, different pathogen species can be distinguished; for instance, while necrotrophic fungi live on dead cells, biotrophic fungi directly derive carbon and nutrients from living cells (Deacon 1997).

The Yedigöller National Park, located in the northern part of Bolu Province in the Western Black Sea Region in Turkey, includes seven lakes and many streams. The park is situated in square A3 of the Davis (1965–85) grid square system. The climate of the province is oceanic, and it rains during all seasons.

The research area comprises primarily mixed forest vegetation. At lower elevations the forest is dominated by *Fagus orientalis*, *Carpinus orientalis*, *Quercus* spp., *Sambucus nigra*, *Sorbus aucuparia*, *S. torminalis*, *Corylus colurna*, *Acer campestre*, *A. platanoides*, *Cornus mas*, *Populus tremula*, and *Alnus glutinosa*. Regions at upper elevations are covered with *Gymnospermae* such as *Abies nordmanniana* subsp. *equi-trojani*, *Pinus nigra*, *P. sylvestris*, and *Taxus baccata*. The understory contains shrubs such as *Daphne pontica*, *Rhododendron ponticum*, and *Juniperus oxycedrus*. The research area is also rich in marshy habitats, and there are aquatic plants in the lake (e.g., *Potamogeton* sp., *Lemna* sp.) and marsh plants surround the edge of the lake (*Typha* sp., *Carex* spp., *Lythrum* sp.).

Materials & methods

Plant specimens infected with microfungi were collected in the Yedigöller National Park, Bolu Province, Turkey. Host specimens were prepared following conventional herbarium techniques. Host plants were identified using the FLORA OF TURKEY AND EAST AEGEAN ISLANDS (Davis 1965–85). Thin sections prepared from infected host tissue were examined under a Leica DM E light microscope and measured from mounts in tap water. Twenty microscopic structures were measured for each sample. Infected host surfaces were photographed using a Leica EZ4D stereo microscope. Species were identified using relevant literature (*Ascochyta*: Vanev & al. 1997, Mel'nik 2000, Połec & Ruszkiewicz-Michalska 2011; *Mycosphaerella*: Ciferri 1956; *Phyllosticta*: Sydow 1899, Cejp 1965; *Rhabdospora*: Winter 1883 [as *Septoria*], Saccardo 1884 [as *Septoria*], Diedicke 1914). All examined specimens were deposited in the Mycological Collection of the Department of Landscape Architects, Faculty of Agriculture, Kırşehir Ahi Evran University, Kırşehir, Turkey (AEUT).

For scanning electron microscopy (SEM), infected leaves were mounted on stubs with double-sided tapes. They were coated with gold in Polaron SC 502 Sputter Coater and examined with Jeol JSM 6060 SEM at 5–10 kV in the Faculty of Science, Gazi University, Ankara, Turkey.

Taxonomy

During our study on microfungi on vascular plants in Yedigöller National Park in Turkey we collected several microfungal species that cause foliar

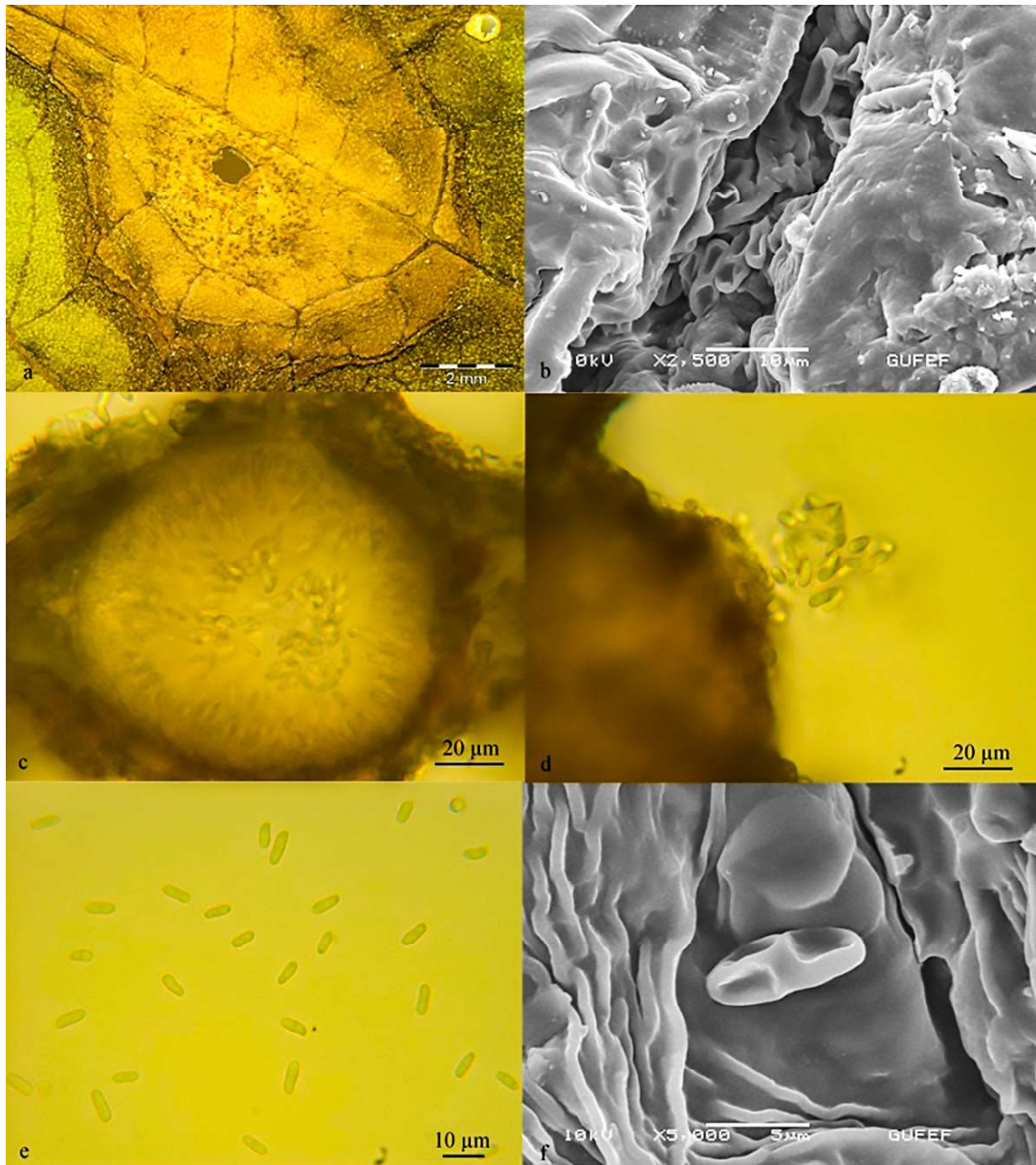


FIG. 1. *Ascochyta daturae* (AEUT GD1376). A. leaf spot (detail) showing pycnidia; B. pycnidia on leaf (SEM); C. pycnidium, vertical section; D, E. conidia; F. conidium (SEM).

spots. A check of the current literature revealed that among the microfungal species causing foliar spots determined in this study, *Ascochyta daturae*, *Ascochyta euonymi*, *Mycosphaerella laureolae*, *Phyllosticta datiscae*, and *Rhabdospora visci* represent new records for Turkey. The list of microfungi with their descriptions, host plants, habitats, localities, collection dates, and voucher numbers follow the classification provided by Index Fungorum (2020) with slight modifications.

Ascochyta daturae Sacc., *Michelia* 1(2): 163 (1878)

FIG. 1

SPOTS visible on both sides of leaves, generally circular or angular, 5–15 mm diam., sometimes elongated 23–45 × 12–15 mm, pale brown, margin of spots dark brown. CONIDIOMATA pycnidial, epiphyllous, aggregated or scattered, unilocular, globose, globose-depressed, semi-immersed, 100–190 × 85–140 μm, light brown; ostiole circular or sometimes papillate, 25–30 μm diam. CONIDIA cylindrical, oblong, ellipsoid, 1-septate, rarely aseptate, straight or slightly curved, not or slightly constricted, both ends rounded, sometimes one end slightly narrowed, 6.4–11 × 2.8–4 μm, guttulate, hyaline.

SPECIMEN EXAMINED—TURKEY, BOLU PROVINCE: Yedigöller National Park, near the Büyük Lake, 40°56'28"N 31°44'51"E, 770 m asl, on living leaves of *Atropa belladonna* L. (*Solanaceae*), 28.06.2018, G. Doğan (AEUT GD1376).

DISTRIBUTION—Bulgaria (Vanev & al. 1997); Canada (Ginns 1986); China (Tai 1979); Poland (Mulencko & al. 2008); Venezuela (Urutiaga 1986).

NOTES: *Ascochyta* consists of facultative parasites that cause diseases of many cultivated and wild plants. A few species are known only from dead parts of their host plants (Mel'nik 2000). In Turkey, *Ascochyta* species are poorly known and not yet intensively studied. Some species of *Ascochyta* were reported by Bremer & al. (1947, 1948), Karel (1958), Göbelez (1964), Parlak & Gucin (1993), Eken (2003), and Kabaktepe & al. (2019). Bahçecioğlu & Kabaktepe (2013) listed 20 *Ascochyta* species from Turkey, on 25 plant species (in 21 genera and 16 families). Mel'nik (2000) synonymised *A. atropae* Bres. (the only species recorded on *Atropa belladonna*) with *A. daturae*, which has been recorded on living and dry leaves and other parts of members of *Solanaceae*. Microscopic features of our specimen corresponded to those given by Mel'nik (2000) and Połec & Ruszkiewicz-Michalska (2011). We observed unicellular conidia on our specimens similar to those reported by Połec & Ruszkiewicz-Michalska (2011).

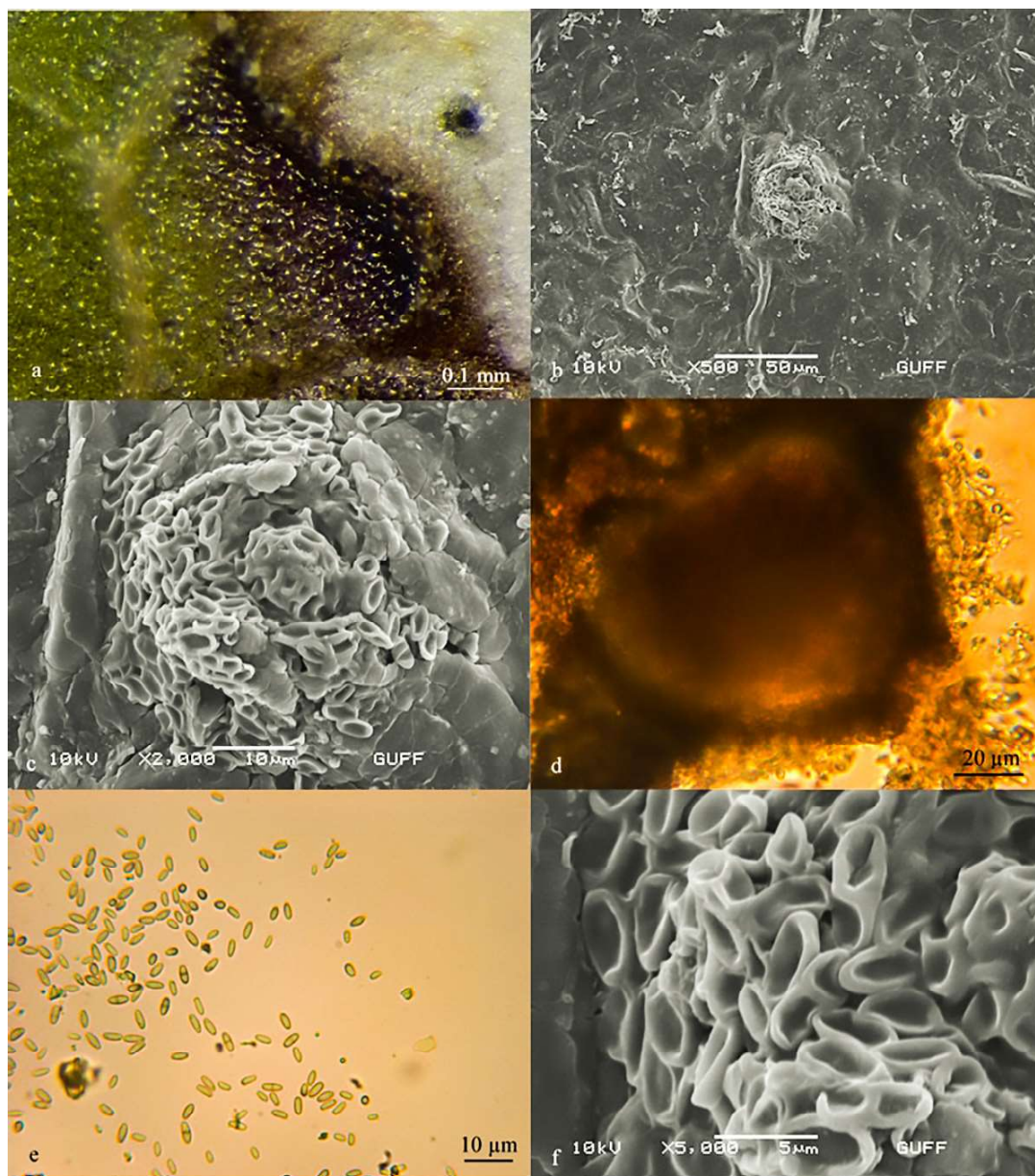


FIG. 2. *Ascochyta euonymi* (AEUT GD1980). A. leaf spots; B, C. pycnidia on leaf (SEM); D. pycnidium, vertical section; E. conidia; F. conidia (SEM).

Ascochyta euonymi Pass., Diagn. Funghi Nuovi 5: 11 (1891)

FIG. 2

SPOTS visible on both sides of leaves, mostly circular, 10–15 mm diam., whitish, surrounded by a brown border. CONIDIOMATA pycnidial, epiphyllous, scattered, unilocular, globose, semi-immersed, 60–115 μm diam., brown; ostiole papillate, 27–40 μm diam. CONIDIA cylindrical, ellipsoid, lanceolate, straight, aseptate or 1-septate, not constricted, both ends rounded, sometimes one end slightly narrowed, 3.8–6.8 × 2–3 μm, guttulate, hyaline.

SPECIMEN EXAMINED—TURKEY, BOLU: Yedigöller National Park, 40°53'45"N, 31°40'06"E, 1627 m asl, on living leaves of *Euonymus verrucosus* Scop. (Celastraceae), 02.08.2019, G. Doğan (AEUT GD1980).

DISTRIBUTION—Czechoslovakia (Farr & Rossman 2020); Georgia (Nakhutsrishvili 1986); Italy (Mel'nik 2000).

NOTES: *Ascochyta euonymi*, *A. euonymella* (Sacc.) Allesch., *A. euonymicola* Allesch., and *A. oudemansii* Sacc. & P. Syd. are reported to infect *Euonymus* spp. (Mulenko & al. 2008, Mel'nik 2000). Our specimen is morphologically similar to *Ascochyta euonymi* as described by previous study (Mel'nik 2000), but differs in having slightly broader, shorter, 1–2-celled conidia.

Mycosphaerella laureolae (Desm.) Lindau,

Nat. Pflanzenfam. 1(1): 424 (1897)

FIG. 3

SPOTS single or confluent, amphigenous, usually circular, irregular when confluent, 5–11 mm diam., at first blackish, becoming brown in the centre, surrounded by a dark ring. PERITHECIA mostly epiphyllous, rarely hypophyllous, usually grouped in the centre of the spots, globose, 65–100 µm diam., blackish; ostiole papillate, 18–20 µm diam. ASCI bitunicate, subcylindric to clavate, attenuate at the base, contracted almost stipitate, 33–50 × 8–10.7 µm. ASCOSPORES biseriate, oblong, ovate or ellipsoid, 1-septate, straight, not constricted, both ends rounded, 12.4–15.8 × 3.6–4.7 µm, guttulate, hyaline.

SPECIMEN EXAMINED—TURKEY, BOLU PROVINCE: Yedigöller National Park, Mengen road separation, 40°56'38"N 31°44'51"E, 741 m asl, on living leaves of *Daphne pontica* L. (Thymelaeaceae), 03.05.2019, G. Doğan (AEUT GD1792).

DISTRIBUTION—Dominican Republic (Ciferri 1956); France, Germany, and Switzerland (Stevenson 1926); Morocco (Rieuf 1970, as *Sphaerella laureolae*).

NOTES: *Mycosphaerella* s.lat. is one of the largest groups of ascomycetes and includes more than 3000 taxa, with species recognized as pathogens or endophytes of many plants, hyperparasites of other fungi, or saprobes (Crous 2009). Our identification of *Mycosphaerella laureolae* agrees with other descriptions of the species with respect to the morphology of perithecia, asci, and ascospores, the only observable difference being the wider dimensions of ascospores and the smaller dimensions of asci. Ciferri (1956) described ascospores measuring 10–15 × 2–3 µm and asci measuring 40–50 × 8–10 µm; and Saccardo (1882) described ascospores measuring 12–14 × 3 µm and asci measuring 44 × 8 µm (as *Sphaerella laureolae*). Here we report *Daphne pontica* as a new host for *Mycosphaerella laureolae*.

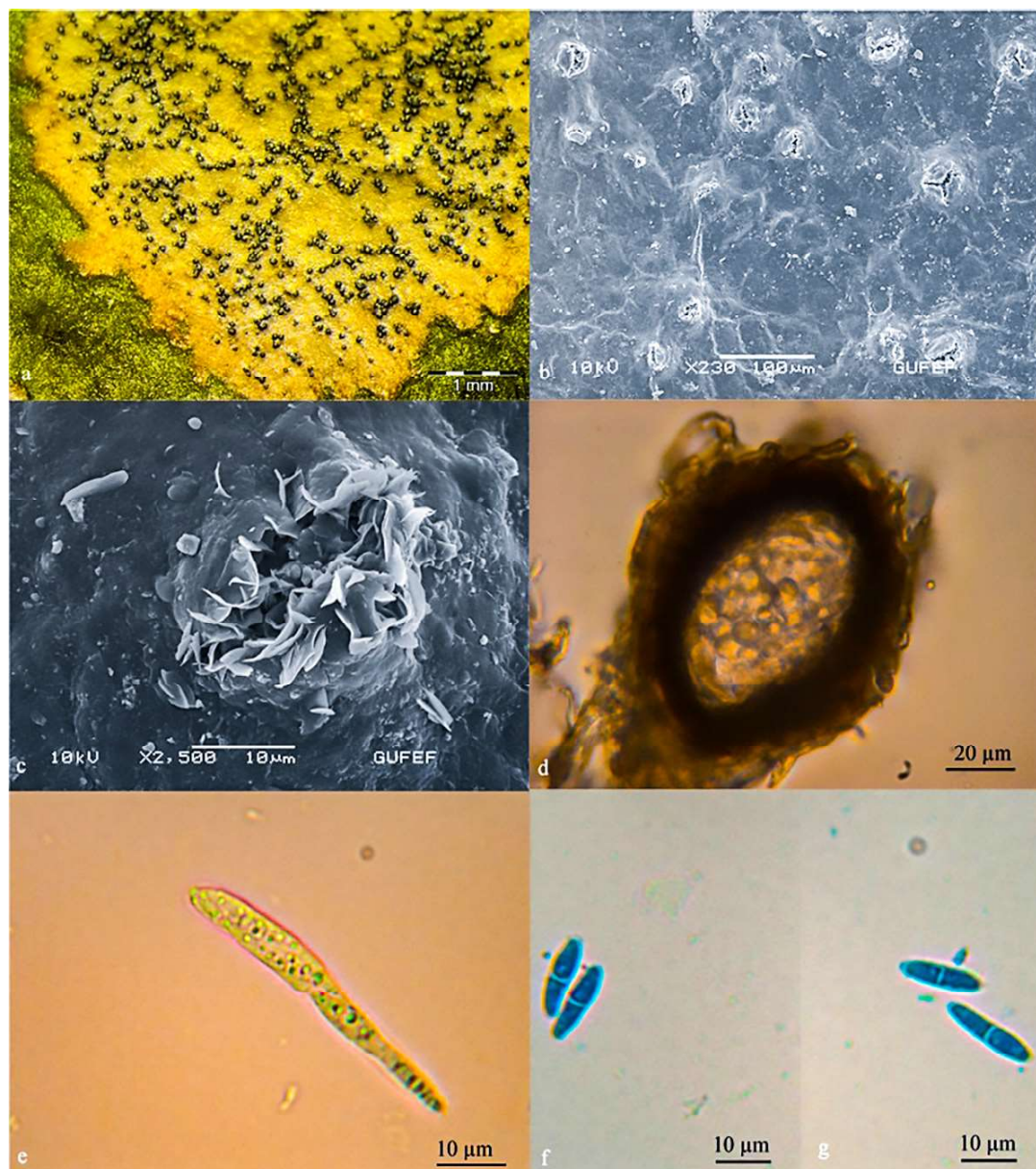


FIG. 3. *Mycosphaerella laureolae* (AEUT GD1792). A. leaf spot (detail) showing perithecia; B. perithecia on leaf (SEM); C. perithecium on leaf (SEM); D. perithecium, vertical section; E. ascus and ascospores; F, G. ascospores mounted in lactophenol cotton blue.

Phyllosticta daticae P. Syd., Beibl. Hedwigia 38: (135) (1899)

FIG. 4

SPOTS amphigenous, orbicular to oblong, often with concentric rings, reaching a diam. of about 1 cm, brown, margin of spots dark brown. CONIDIOMATA pycnidial, epiphyllous, scattered, unilocular, globose-depressed, semi-immersed, $110\text{--}135 \times 70\text{--}100 \mu\text{m}$, brown; ostiole papillate. CONIDIA one-celled, oblong, ellipsoid, rounded at both ends, $5.5\text{--}6.9 \times 2.2\text{--}2.7 \mu\text{m}$, biguttulate, hyaline.

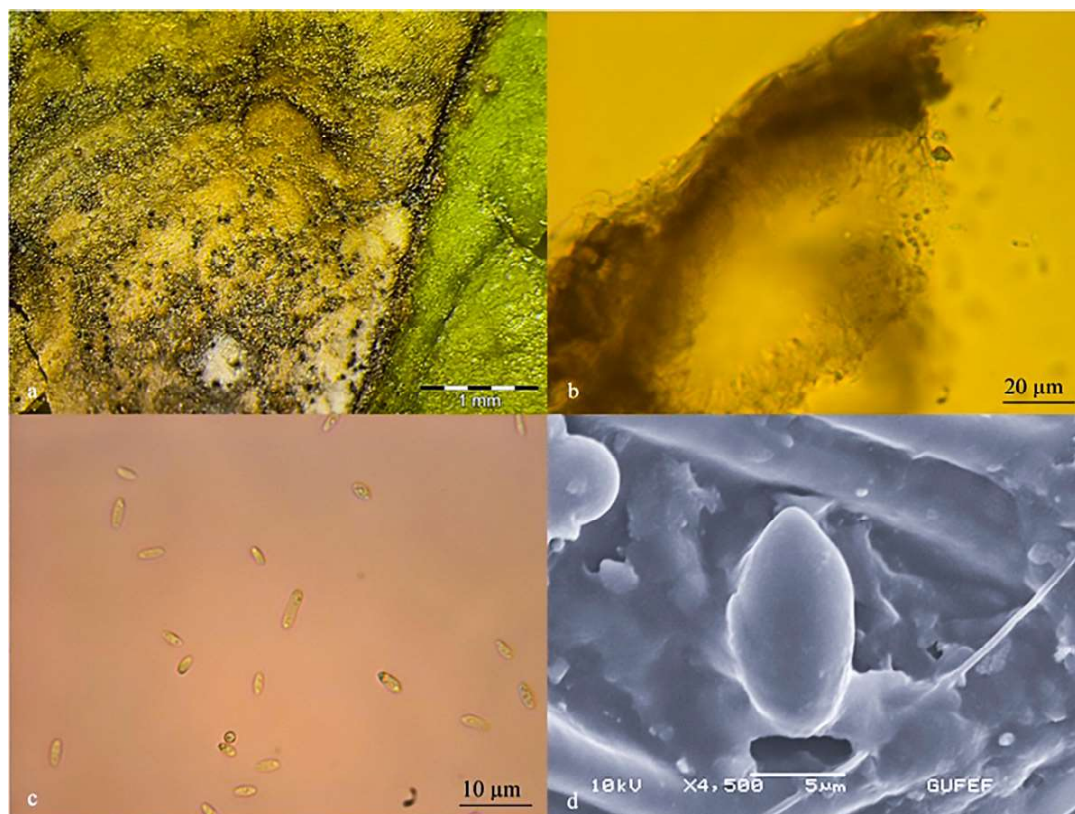


FIG. 4. *Phyllosticta datiscae* (AEUT GD2041). A. leaf spot (detail) showing pycnidia; B. pycnidium, vertical section; C. conidia; D. conidia (SEM).

SPECIMENS EXAMINED—TURKEY, BOLU PROVINCE: Yedigöller National Park, 40°56'52"N 31°45'02"E, 716 m asl, on living leaves of *Datisca cannabina* L. (*Datisceae*), 27.06.2018, G. Doğan (AEUT GD1328); Mengen road separation, 40°56'30"N 31°44'40"E, 811 m asl, on living leaves of *Datisca cannabina*, 03.08.2019, G. Doğan (AEUT GD2041).

DISTRIBUTION—Germany (Sydow 1899), Czechoslovakia (Cejp 1965).

NOTES: *Phyllosticta* is an important genus of plant pathogenic fungi, causing leaf spots and various fruit diseases worldwide on a large range of hosts (Aa & Vanev 2002). Species recognition in *Phyllosticta* has historically been based on morphology, culture characters, and host association. Although there have been several taxonomic revisions and enumerations of species, there is still considerable confusion when identifying taxa (Wikee & al. 2011). *Phyllosticta datiscae* is the only species of *Phyllosticta* described on *Datisca cannabina*. The Turkish specimens agree with the description by Sydow (1899) in leaf spot, conidiomatal, and conidial morphology, except that the conidiomata are larger and the conidia smaller; in comparison with the description and illustration by Cejp (1965), the Turkish conidia were thicker and 1–2-celled.

Rhabdospora visci (Bres.) Died.,

Krypt.fl. Brandenburg 9(3): 537 (1914 ["1915"])

FIG. 5

LEAF SPOTS amphigenous, raised, circular, 2–4 mm diam. or confluent and larger, pale brown, surrounded by a reddish-brown border. CONIDIOMATA pycnidial, mostly hypophyllous, scattered or in groups, unilocular, subglobose, immersed, later becoming erumpent, 175–350 μm diam., dark brown. CONIDIA filiform, straight or slightly curved, 1–3-septate, non-

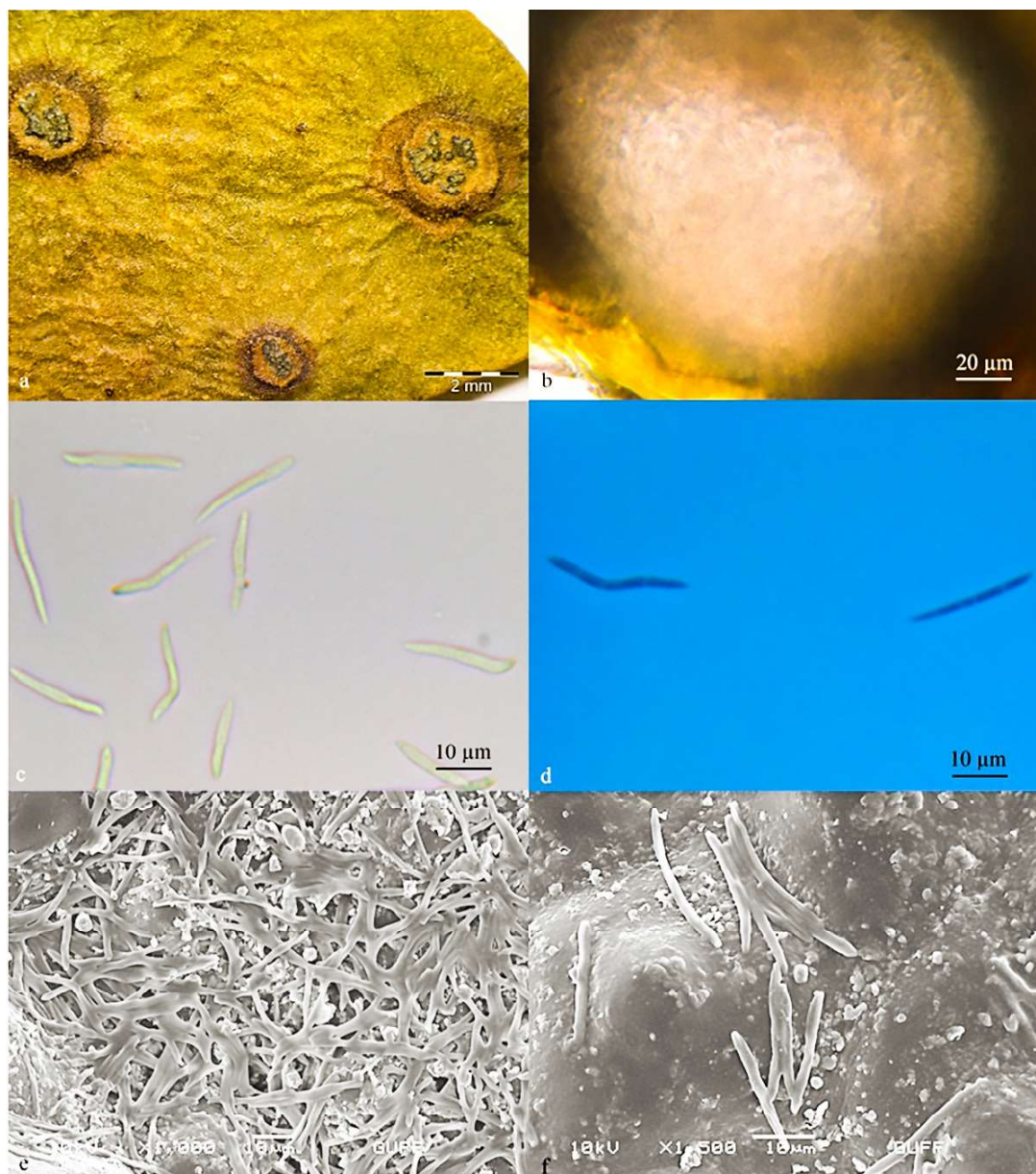


FIG. 5. *Rhabdospora visci* (AEUT GD 2014). A. leaf spot (detail) showing perithecia; B. perithecium, vertical section; C. conidia; D. ascospores mounted in lactophenol cotton blue; E, F. conidia (SEM).

constricted at the septum, attenuated both ends, (18.5–)24.6–36 × 2.2–2.9 µm, guttulate, hyaline.

SPECIMEN EXAMINED—TURKEY, BOLU PROVINCE: Yedigöller National Park, 40°93'58"N 31°75'39"E, 1083 m asl, on living leaves of *Viscum album* subsp. *abietis* (Wiesb.) Abrom. (*Santalaceae*), 02.08.2019, G. Doğan (AEUT GD 2014).

DISTRIBUTION—Austria/Italy (Winter 1883, as *Septoria visci*); Germany (Diedicke 1914); Hungary (Geza & al. 2009, as *Septoria visci*); Italy (Farr & Rossman 2020, as *Septoria visci*); Serbia and Bosnia and Herzegovina (Stanivuković & al. 2010, as *Septoria visci*).

NOTES: Biological control of parasites by using plant pathogens has gained acceptance as a practical, safe and environmentally beneficial management method applicable to agro-ecosystems (Charudattan 2001). Control of European mistletoe is a major problem for the forest service in Turkey (Yüksel & al. 2005). More than 20 microscopic fungi live on European mistletoe, but only a few of them cause major damage on the plant (Karadžić & al. 2004). Of these, *Rhabdospora visci*, which causes leaf spot disease of European mistletoe, appears to have potential as a biological control agent against of this semiparasite.

This species was initially described as *Septoria visci* on leaves of *Viscum album* parasitising gymosperm trees in South Tyrol (Winter 1883). It was later transferred to the genus *Rhabdospora* by Diedicke (1914). Our specimen of *Rhabdospora visci* was morphologically similar to specimens described by previous studies (Winter 1883, Diedicke 1914) but differed in having slightly thicker and shorter conidia.

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