

## Taxonomy of *Botryosphaeria melanops* and its anamorph, *Fusicoccum advenum*

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The nomenclatural history of *Botryosphaeria melanops* and its anamorph is presented as well as descriptions based on types or other critical herbarium specimens. Because type material of *B. melanops* is missing, a neotype is designated. The anamorph of *B. melanops*, frequently referred to as *Dothiorella advena*, is shown to be *Fusicoccum advenum*.

Keywords: *Botryosphaeria advena*, *Dothidea melanops*, *Dothiorella advena*, *Fusicoccum testudo*, *Melanops tulasnei*, systematics

When Cesati & De Notaris (1863, pp. 211–213) described the genus *Botryosphaeria* they listed nine species (plus an additional six species that they did not recombine in the genus), but they did not designate a type. Subsequently, Saccardo (1877, pp. 42–43) emended the genus to exclude hypocreaceous species. Von Höhnel (1909, pp. 840–843) designated *B. berengeriana* De Not. as the type, but this species was not included in the original description of the genus, although it was published soon after (De Notaris, 1864, p. 82–83). Theissen & Sydow (1915, pp. 661–665) suggested *B. quercuum* (Schwein.) Sacc. as the type since it was typical of Saccardo's (1877) emendation of *Botryosphaeria*, and this was accepted by von Arx & Müller (1954, p. 26). However, *B. quercuum* also was not one of the original species of the genus and therefore is unsuitable as the type. Barr (1972, pp. 556–557) proposed *B. dothidea* (Moug.: Fr.) Ces. & De Not. as lectotype because it was one of the original species described, it conforms with Saccardo's (1877) emendation, and it is an earlier synonym of *B. berengeriana*, von Höhnel's (1909) designated type. Barr's (1972) proposal has been generally accepted.

*Botryosphaeria advena* (Ces.) Ces. & De Not. (based on *Dothidea advena* Ces., Erb. Crittog. Ital. N° 495) was one of the nine *Botryosphaeria* species originally listed by Cesati & De Notaris (1863). As with their other eight species, they did not provide a detailed mor-

phological description. Saccardo (1877, p. 42) redescribed *B. advena* from a specimen collected from oak branches at Altichiero, Padova, including it in his emended concept of the genus.

The name *Dothidea melanops* Tul. was first mentioned, as a nomen nudum, by Tulasne (1856a, p. 705), and later provided with a brief Latin description (Tulasne, 1856b, p. 116). In their *Selecta Fungorum Carpologia*, Tulasne & Tulasne (1863, pp. 73–75) gave a detailed and well-illustrated account of the fungus. They also suggested that a specimen labelled as *Sphaeria quercina* (Fries, Scler. Suec. Exs., fasc. V, N<sup>o</sup> 143, in Weddel's herbarium) is conspecific with *Dothidea melanops*. However, this misapplication of the name *Sphaeria quercina* has no relevance to the nomenclature of *D. melanops*, and moreover Fries' specimen is pycnidial according to the additional notes of Tulasne & Tulasne (1863, p. 298).

Nitschke (Fuckel, 1870, p. 225) considered *Dothidea melanops* to be a species of *Melanops* and applied the new name of *Melanops tulasnei* Nitschke, presumably to avoid the tautonym *Melanops melanops*. Winter (1887, pp. 800–801) was of the opinion that *M. tulasnei* and *B. advena* sensu Saccardo (1877) were identical, but stated that they differed from *B. advena* (Ces.) Ces. & De Not. Winter (1887) did, however, agree that *D. melanops* would be better accommodated in *Botryosphaeria* and made the new combination *B. melanops* (Tul.) G. Winter. Subsequently, von Arx & Müller (1954, pp. 33, 34) included both *B. advena* and *B. melanops* under their broad concept of *B. quercuum*.

The name *Dothiorella advena* Sacc. is commonly used for the anamorph of *B. melanops* (Shear & Davidson, 1936; Shoemaker, 1964; Sivanesan, 1984). However, the genus *Dothiorella* has been the source of much confusion, and when Crous & Palm (1999) examined the type of *Dothiorella* they confirmed Cooke's (1871, p. 429, sub *Dothiora pyrenophora*) observation that the conidia are indistinguishable from those of a *Diplodia* species. For this reason *Dothiorella* is considered to be a synonym of *Diplodia*.

When Saccardo (1882, p. 620) described *Dothiorella advena*, he regarded it as the asexual form of *Botryosphaeria advena*, presumably based on the close proximity of the two on the host. However, he was referring to his (Saccardo, 1877) concept of *B. advena*, and not that of Cesati & De Notaris (1863). Much later, Shear & Davidson (1936) proved, by culture of ascospores, that *D. advena* is the anamorph of *B. melanops*.

Von Höhnelt (1903, pp. 399–400) described *Fusicoccum testudo* as a new anamorphic species on *Quercus*. Subsequently, Diederich (1915, p. 314) transferred *Dothiorella advena* to *Fusicoccum* and made the new combination *Fusicoccum advenum* (Sacc.) Died., citing *F. testudo* as a synonym and *B. melanops* as the teleomorph.

The aim of the present work was to clarify the status of these fungi through a study of types and other herbarium specimens related to *B. melanops* and *D. advena*.

### Materials and Methods

Ascomata and conidiomata taken from herbarium specimens were soaked briefly (1–2 min) in 3% KOH. The KOH was replaced with water, and the conidiogenous layer or asci were dissected out and mounted in 100% lactic acid. Sections of conidiomata and ascomata were cut by hand, soaked in 3% KOH and then mounted in lactic acid. Digital images were recorded with a Leica DFC320 digital camera and measurements made with the Leica IM 500 measurement module. When sufficient material was available, 50 measurements were made of each structure and the mean and standard deviation calculated. Data for spore measurements are given as the 95% confidence intervals with maximum and minimum values in parentheses.

### Results and Discussion

We were unable to locate the type material of *Dothidea melanops* (not in P(C)), but we examined the specimen in PAD that Saccardo referred to in his description of *B. advena* (Saccardo, 1877). This specimen, on *Quercus*, was collected from Altichiero in June 1876. Saccardo noted on the packet that it is the ascogenous state (ascoph.), and gave it the name *Botryosphaeria advena*, under which he wrote the name *D. melanops*. The large rhomboid ascospores ( $32\text{--}40 \times 13\text{--}16 \mu\text{m}$ ) and clavate asci ( $150\text{--}240 \times 30\text{--}48 \mu\text{m}$ ) of this specimen fit within the descriptions of *Dothidea melanops* given by Tulasne (1856b) and Tulasne & Tulasne (1863). In the absence of the type, which could not be located in this study, this specimen would appear to be a suitable neotype.

In addition, we examined *Dothidea advena*, Erb. Critt. Ital. N° 495 (RO). A note on this sheet by Traverso in 1905 indicated that he considered *D. advena* to be a synonym of *B. berengeriana*. Later, Traverso (1907, p. 412) confirmed this synonymy. Slippers & al. (2004) examined the holotype of *B. berengeriana* and compared it with their proposed epitype of *B. dothidea*. Taking into account the original description of *B. berengeriana*, Slippers & al. (2004) could find no reason to resurrect this name and accepted the synonymy with *B. dothidea* proposed by von Arx & Müller (1954, p. 37). In our examination of Erb. Critt. Ital. 495, we found that the ascomata were erumpent through the host bark, and formed botryose aggregates.



Asci were bitunicate, clavate,  $60\text{--}120 \times 15\text{--}20 \mu\text{m}$ , 8-spored. The ascospores were fusoid to ovoid,  $18\text{--}25 \times 7\text{--}9 \mu\text{m}$ , biseriate in the ascus, hyaline, aseptate, thin-walled. These characters fit within the description of *B. dothidea* provided by Slippers & al. (2004), and therefore we agree that *D. advena* is a synonym of *B. dothidea* (and not a synonym of *B. quercuum*, as suggested by von Arx & Müller, 1954, p. 33). Furthermore, in Erb. Critt. Ital. 495, we found the anamorph in the same stroma as the teleomorph. Conidia were fusiform and measured  $25\text{--}30 \times 5\text{--}6 \mu\text{m}$ , thus correlating with the dimensions reported for *Fusicoccum aesculi* Corda (Crous & Palm, 1999; Slippers & al., 2004), which is considered to be the anamorph of *B. dothidea*. This confirms that *D. advena* Ces. and *B. advena* sensu Saccardo (1877) are not conspecific, but are synonyms of *B. dothidea* and *B. melanops*, respectively.

We examined the type specimen of *Dothiorella advena* (PAD 768) and found the characters and dimensions of the conidia to correlate well with those given by Saccardo (1882) and Shear & Davidson (1936). This is a typical *Fusicoccum* with stromatic conidiomata, and fusiform, hyaline, thin-walled, aseptate conidia produced on phialides. The conidia ( $37\text{--}53 \times 7\text{--}11 \mu\text{m}$ ) are larger than in any other species described in this genus and the transfer proposed by Diedicke (1915) is supported. The connection between the anamorph and teleomorph was established by Shear & Davidson (1936).

### Taxonomy

***Botryosphaeria melanops*** (Tul.) G. Winter, Rabenh. Krypt.-Fl. Ed. 2, 1 (2): 800, 1886 (1887). Figs 1–7

- ≡ *Dothidea melanops* Tul., Compt. Rend. Hebd. Séances Acad. Sci. 42: 705, 1856, nom. nud.
- ≡ *Dothidea melanops* Tul., Ann. Sci. Nat. Bot., 4<sup>e</sup> Sér., 5: 116, 1856.
- ≡ *Melanops tulasnei* Nitschke, in Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 225, 1870 (1869–70), nom. nov.

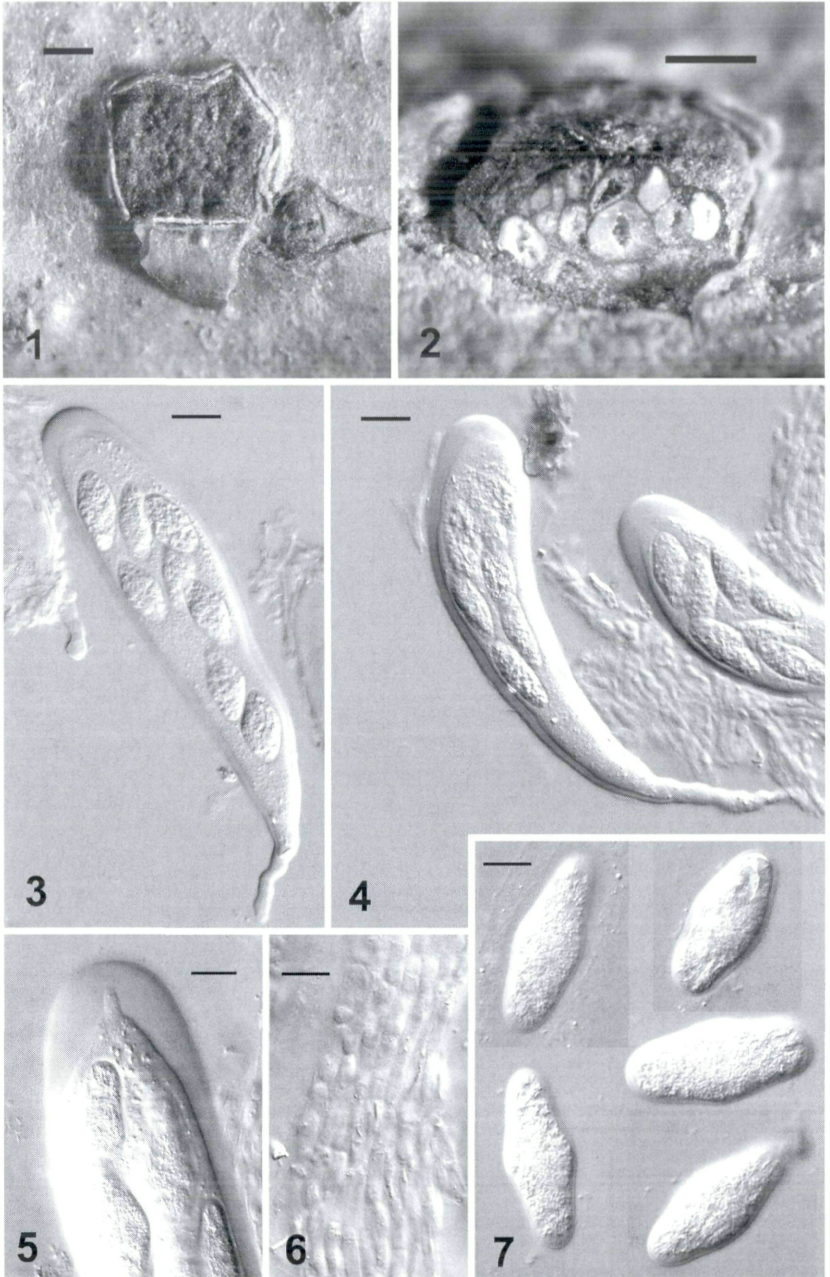
**Neotype:** labelled as *Botryosphaeria advena* [misapplied name], on *Quercus*, Altichiero, Italy, June 1876, Herbarium Mycologicum P. A. Saccardo, Padova; designated here.

Misapplied name:

*Botryosphaeria advena* sensu Sacc., Michelia 1(1): 42, 1877, non (Ces.) Ces. & De Not., 1863 [fide Winter, 1886; Traverso, 1907].

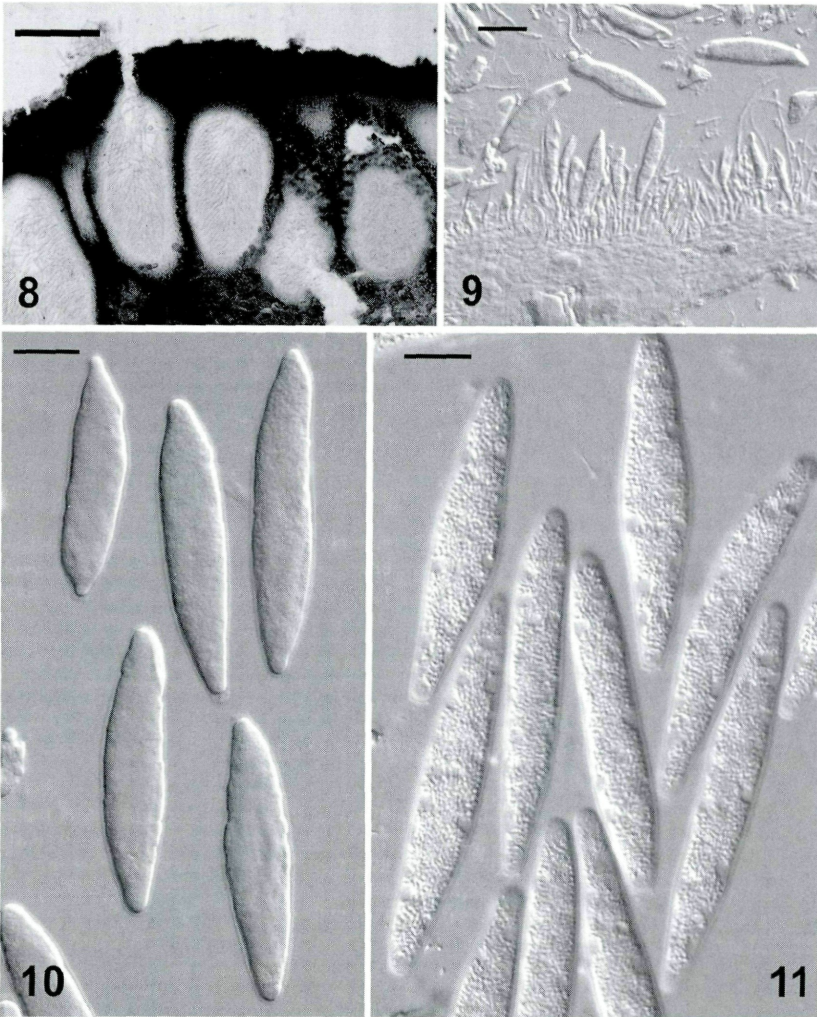
**Anamorph: *Fusicoccum advenum*** (Sacc.) Died., Krypt. Fl. Brandenburg 9: 314, 1912 (1915). Figs 8–11

- ≡ *Dothiorella advena* Sacc., Michelia 2(8): 620, 1882.
- = *Fusicoccum testudo* Höhn., Ann. Mycol. 1(5): 399, 1903 [fide Diedicke, 1915; Shear & Davidson, 1936].
- = *Dothiorella melanops* Traverso, Fl. Ital. Crypt., Fungi 2(2): 409, 1907 [microconidial state].



Figs. 1-7. *Botryosphaeria melanops* in Herb. P. A. Saccardo, PAD, Altichiero, June 1876. - 1. Ascoma erumpent through host bark. - 2. Section through an ascoma showing several locules. - 3, 4. Asci. - 5. Ascus tip with apical chamber. - 6. Pseudoparaphyses. - 7. Ascospores. Bars: 1, 2 = 0.5 mm; 3, 4 = 20  $\mu$ m; 5-7 = 10  $\mu$ m.





Figs. 8–11. *Fusicoccum advenum*. – 8–10. PAD 768 (Type). – 8. Sectioned conidioma. – 9. Conidiogenous layer. – 10. Conidia. – 11. Conidia ex Herb. G. von Winter. Bars: 8 = 200  $\mu$ m; 9 = 20  $\mu$ m; 10, 11 = 10  $\mu$ m.

Misapplied name:

*Sphaeria quercina* sensu Fr., Scler. Suec. Exs. N<sup>o</sup> 143, 1821, non Pers. : Fr., 1794 [fide Tulasne & Tulasne, 1865; Shear & Davidson, 1936].

Ascomata up to 2 mm diameter, pseudothecial, initially immersed, partially erumpent at maturity, black, multilocular, thick walled, wall composed of pseudoparenchymata, outer layers composed of thick-walled, brown *textura angularis*, becoming progres-

sively thinner-walled and paler towards the loculi, individual locules 150–300  $\mu\text{m}$  diameter. – Ostioles circular and central on each locule, papillate. Pseudoparaphyses 3–4  $\mu\text{m}$  diam., thin-walled, hyaline, frequently septate, constricted at the septum. Asci 150–240  $\times$  30–48  $\mu\text{m}$ , clavate, stipitate, bitunicate with a well developed apical chamber, eight-spored, irregularly biseriate. – Ascospores (30–)37.5–40.9(–47.0)  $\times$  (13.0–)15.1–16.3(–19.0)  $\mu\text{m}$ , rhomboid, widest in the middle, narrowing abruptly from the middle then tapering gradually to the apices, thin walled, smooth, hyaline, aseptate but becoming pale brown and one- or two-septate with age.

Conidiomata indistinguishable from ascomata and often formed in the same stroma. Paraphyses filiform, arising between the conidiogenous cells. Conidiogenous cells cylindrical, hyaline, unbranched, discrete, formed from the inner wall of the conidioma, forming a single conidium at the tip and proliferating percurrently to form one or two annellations, or proliferating at the same level giving rise to periclinal thickenings. Conidia (37.2–)45.0–46.8(–53)  $\times$  (7.2–)9.1–9.7(–12.1)  $\mu\text{m}$ , hyaline, aseptate, fusiform, widest in the middle, apex acute, base truncate with a minute marginal frill.

Specimens examined. – *Dothidea advena* Ces., on bark of *Ampelopsis hederacea*, Caluso, Italy, 2 August 1860, leg. Cesati & Malinverni, Erbario Crittogamico Italiano 495 (type); on branch of *Quercus* sp., Leipzig, Germany, December 1865, Auerswald, Rabenhorst Fungi Europaei Exsiccati 1034, (conidial state only); on *A. hederacea*, collection date unknown, collector unknown, Rabenhorst Fungi Europaei Exsiccati 546; on branch of *A. hederacea*, Pisano, November 1862, O. Beccari, Rabenhorst Fungi Europaei Exsiccati 646.

*Botryosphaeria advena* Ces. & De Not., on *Quercus*, Altichiero, Italy, June 1876, Herbarium Mycologicum P. A. Saccardo, Padova; C. Roumeguère, Fungi Gallici Exsiccati 1547.

*Dothidea melanops* Tul., on branch of *Quercus*, Leipzig, Germany, April 1862, leg. Auerswald, Herb. G. von Winter ex Herb. von Thümen.

*Dothiorella advena* Sacc., on branch of *Quercus* sp., locality unknown, collection date unknown, Herbarium Mycologicum P. A. Saccardo, Padova 768 (type).

*Melanops tulasnei* Nitschke sec. Fuckel, on dead branch of *Ampelopsis quinquefolia*, 1875, Parma, Italy, leg. Passerini, de Thümen Mycotheca Universalis 1159.

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