

## The hyphomycete genus *Heterosporiopsis* Petrak<sup>1</sup>

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The type species of the anamorphic genus *Heterosporiopsis* Petrak, *H. monilifera* Petr., is illustrated and redescribed from its holotype and from the holotype of its avowed teleomorph *Dimerosporium moniliferum* Pat. The avowed anamorph of *Dimerium olivaceum* H. Syd. & P. Syd. is now considered to be a *Heterosporiopsis*. The various dispositions of the congeneric teleomorphs are reviewed; none is considered suitable, but no attempt is made to resolve this problem.

Key words: hyphomycete taxonomy, *Dimerium*, *Dimerosporium*

The name *Heterosporiopsis* Petrak, type species *H. monilifera* Petr. (as '(Pat.) Petr. n. spec.'), was proposed in 1950 for the anamorph of *Dimerosporium moniliferum* as illustrated and described by Patouillard in Patouillard & Lagerheim (1892). This anamorph and some features of the teleomorph are herein illustrated or described. The anamorph of the so-called *Dimerium olivaceum* H. Sydow & P. Sydow, as recently illustrated and described by Hughes (1993), is now identified as congeneric with *H. monilifera* and is briefly noted below.

Teleomorphs of both species are apparently congeneric but current taxonomy indicates that their previous disposition in either *Dimerosporium*, *Dimerium*, *Periline*, *Antennularia* or *Protoventuria* is unsuitable. These problems are briefly discussed. Designation of an appropriate genus will require further comparative studies.

### Taxonomy

***Heterosporiopsis monilifera*** Petrak, *Sydowia* 4: 522. 1950. – Fig. 1.  
as "(Pat.) Petr. n. spec. Syn. *Dimerosporium moniliferum* Pat. ...  
p.p."

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Teleomorph. – *Dimerosporium moniliferum* Patouillard in Patouillard & Lagerheim, Bull. Soc. Mycol. France 8: 128. 1892.

≡ *Dimerium moniliferum* (Pat.) P. A. Saccardo & D. Saccardo, Sylloge Fungorum, (Supplementum Universale pars VI) 17: 537. Patavii [Padua]: Typis Seminarii. 25 May 1905.

≡ *Periline monilifera* (Pat.) Petrak, Sydowia 4: 521. 1950.

≡ *Antennularia monilifera* (Pat.) Müller in Müller & von Arx, Die Gattungen der didymosporen Pyrenomyceten. Beiträge zur Kryptogamenflora der Schweiz. 11(2): 436. 1962.

≡ *Protoventuria monilifera* (Pat.) A. Sivanesan, Trans. Br. mycol. Soc. 63: 591. 1974.

Colonies are dark brown to black, epiphyllous, up to 5 mm wide, circular, composed of a hyphal weft, thin at the margin and centrally denser.

The superficial mycelium is composed of radiating and reticulate brown to pale brown hyphae that arise from a central group of cells. Immersed hyphae are subcuticular, hyaline to pale brown, dendritic, closely appressed, one cell thick and forming an extensive

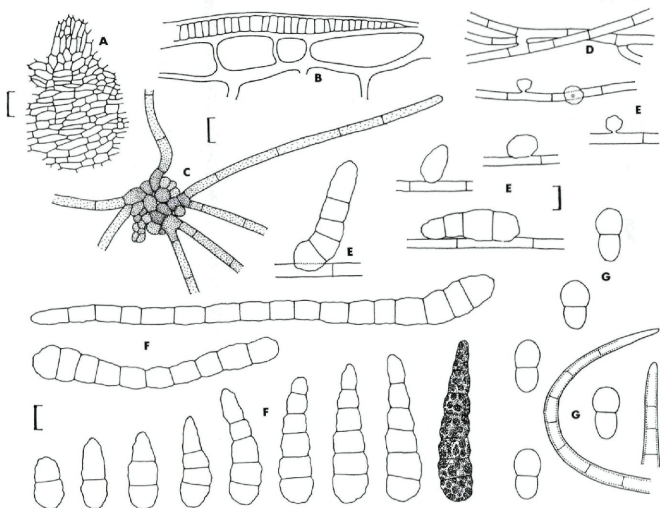


Fig. 1. – *Heterosporopsis monilifera*. – A, B, subcuticular hyphae; A, in surface view; B, in vertical section; C, superficial hyphae arising from erumpent groups of cells; D, anastomosed superficial hyphae; E, attached conidium initials; F, detached young and mature conidia; G, perithecial setae and five ascospores of the teleomorph *Dimerosporium moniliferum*. – From the holotype collection of *Heterosporopsis monilifera* Petrak. Scales = 10  $\mu$ m.

plate below the superficial hyphae: component cells are cylindrical to irregular, 4–10  $\mu\text{m}$  long and 2–4.0  $\mu\text{m}$  wide. At the centre of a colony, subcuticular hyphae form an emergent dome-like, brown to dark brown aggregation of cells: these are ellipsoidal to subglobose, and bear one or two radiating, superficial hyphae that are brown, paler toward their ends, 3.5–5.5  $\mu\text{m}$  wide, mostly straight or gently flexuous, frequently anastomosed, finely roughened, septate at 17–45  $\mu\text{m}$  intervals, branched usually at an acute angle with the branches borne singly or paired. Toward the centre of a colony superficial hyphae are crowded, laterally appressed to form a dense overlapping stratum of hyphae. The means of ingress of the fungus through the cuticle to form the subcuticular mycelium is unknown. – No hyphopodia were seen.

Conidia are produced irregularly on superficial hyphae. They are sessile or occasionally develop on a subglobose, brown, rough-walled cell 7–7.5  $\mu\text{m}$  wide. Conidium initials are subglobose to ellipsoidal and arise blastically at a small locus on a hyphal wall: They expand to become obclavate and are finally up to 138(–172)  $\mu\text{m}$  long, (11–)12.5–18  $\mu\text{m}$  wide and up to 12(–16)-septate, tapering to 7–9  $\mu\text{m}$  wide toward the distal end, dark brown throughout, coarsely warted by the irregular fracture of an outer darker wall layer, straight or gently curved, and slightly constricted at the septa. Mature conidia secede very readily from the hyphae (or globose cells) that bear them; the scar on the conidium is inconspicuous and basal but frequently lateral, indicating that such conidia have developed more or less parallel with the hyphae that bear them. Conidium length and septation vary considerably as shown in the following series of measurements: 27–45  $\times$  12.5–14.5  $\mu\text{m}$  (2-septate), 36–41.5  $\times$  (11) 12.5–14.5  $\mu\text{m}$  (3-septate), 43–54  $\times$  12.5–15  $\mu\text{m}$  (4-septate), 59–65  $\times$  14.5–16  $\mu\text{m}$  (5-septate), 70–79  $\times$  13.5–17  $\mu\text{m}$  (6-septate), 77–90  $\times$  14.5–16  $\mu\text{m}$  (7-septate), 90–93  $\times$  14.5–16  $\mu\text{m}$  (8-septate), 93–101  $\times$  12.5–16  $\mu\text{m}$  (9-septate), 104–108  $\times$  12.5–17  $\mu\text{m}$  (10-septate), 126  $\times$  18  $\mu\text{m}$  (11-septate) and 75–138  $\times$  18–23  $\mu\text{m}$  (12-septate). Conidia up to 172  $\mu\text{m}$  long and 16-septate are very uncommon and may represent conidia that have germinated at the apex.

Perithecia develop from superficial ascogonial coils and are scattered, superficial, black, subglobose, 180–210  $\mu\text{m}$  diam. (150  $\mu\text{m}$  *vide* Patouillard, in Patouillard & Lagerheim, 1892). They bear numerous (up to 50) upwardly curved, setoid appendages that are concolorous with the hyphae, tapered toward the apex, up to 190  $\mu\text{m}$  long, thick-walled (ca. 2  $\mu\text{m}$ ), with up to 8 thin septa, 6–7.5  $\mu\text{m}$  wide at the base: also present are hyphoid appendages attached to the lower half of perithecia and free or anastomosed distally with the hyphae appressed to the leaf surface. – *Hamathecium* of pseudoparaphyses.

Asci are saccate to oblong to ellipsoidal, apically thickened, fissitunicate, 8-spored, and young asci with ascospore initials are  $80\text{--}100 \times 20\text{--}23 \mu\text{m}$ . – Ascospores are 1-septate, smooth, clavulate, pale brown, constricted at the septum with the upper cell mostly broader and shorter than the lower cell: they measure  $20.5\text{--}27 \times 12.5\text{--}13.5 \mu\text{m}$ .

Collections examined. – CHILE, Quebrada de la Carolina, Pichincha, on leaves of *Gynoxis laurifolia* Cass. (Asteraceae). July 1891, Lagerheim, in Herb. FH. HOLOTYPE of *Dimerosporium moniliferum* Patouillard. – ECUADOR, prov. Tungurahua, Hacienda San Antonio bei Banos, on leaves of *Gynoxis*, January 1938, H. Sydow. Petrak Herb. No. 32196 in Herb. W. HOLOTYPE of *Heterosporiopsis monilifera* Petrak.

***Heterosporiopsis*** anamorph of '*Dimerium olivaceum*' H. Sydow & P. Sydow, *Annales mycologici* 2: 169. 1904.

Holotype. – CHILE: Valdivia, on leaves of *Cynoctonum nummulariifolium* Deene (*Vincetoxicum nummulariifolium*). Feb. 1897. F. W. Neger. (Herb. S).

The holotype was illustrated and redescribed by Hughes (1993). The coarsely warted conidia closely resemble those of *H. monilifera*, but are wider,  $12.5\text{--}18\text{--}(22) \mu\text{m}$ . Also, ascospores of '*Dimerium olivaceum*' are markedly smaller,  $17\text{--}20 \times 7.2\text{--}9 \mu\text{m}$ , than those of '*Dimerosporium moniliferum*'.

It must be pointed out that the ascus and ascospores of Fig. 134C in Hughes (1993) should have been accompanied by a bar 12 mm long to indicate 10  $\mu\text{m}$ .

### Discussion

The conidia of *H. monilifera* develop directly from hyphae of the superficial mycelium, or from small, globose conidiogenous cells occurring laterally on the hyphae of the superficial mycelium, by an apparently holoblastic process. There are three comparable hyphomycete genera with reduced or completely integrated conidiogenous cells and pigmented phragmoconidia. *Antennatula* Fr. (1849) ex F. Strauss (1850), typified by *A. pinophila* (Nees) Strauss is the most similar and also apparently has holoblastic conidium development. Species of this genus, however, have entirely superficial hyphae that are wider and more closely septate, and display right-angled branching; furthermore, a *Hormisciomyces* Bat. & Nasc. phialidic synanamorph and an *Euantennaria* Speg. teleomorph with 3- to 11-septate dematiaceous ascospores are produced (Hughes 1970). The lichenicolous *Sessiliospora* D. Hawksw. (Hawksworth 1979), typified by *S. bicolor*, and the closely related foliicolous *Sanjuanomyces*

Castañeda & Kendrick (1991), typified by *S. elegans*, both have monotretic conidium ontogeny.

The teleomorph of *Heterosporiopsis monilifera* has been included in *Dimerosporium* Fuckel (1870), '*Dimerium*' Auctores, *Periline* H. Sydow (1939), *Protoventuria* Berlese & Saccardo (1886) and *Antennularia* Reichenbach (1828). The teleomorph of the second species of *Heterosporiopsis* has been included only in *Dimerium*. None of these generic names, however, is suitable for the congeneric teleomorphs of the two *Heterosporiopsis* anamorphs.

The type species of *Dimerosporium*, *D. abjectum* (Wallr.) Fuckel, is an *Asterina* Léveillé, *A. veronicae* (Lib.) M.C. Cooke, according to Müller & von Arx (1962) and this genus is thus quite unsuitable.

*Dimerium* has had a checkered history since its origin as a subgenus of *Dimerosporium*. Hughes (1993) had overlooked the McAlpine (1903) publication as well as that of Gams (1992) and considered *Dimerium* to have been first used at the generic level by H. Sydow and P. Sydow (1904, 15 Apr.). These latter authors had described a new species '*Dimerium olivaceum*' and Hughes regarded this as a 'descriptio generico-specifica'. However as pointed out by Gams, McAlpine had earlier raised subgenus *Dimerium* to generic rank. Accordingly *Dimerium tasmanicum* (Masse) McAlp. must be the type species of *Dimerium* (Sacc. & Syd.) McAlp.: it is the only representative of the four original species in the subgenus that was included in the genus *Dimerium* by McAlpine. *Dimerium tasmanicum* was redescribed and illustrated from the holotype by Hansford (1954) as *Maireella tasmanica* (McAlp.) Hansf.

Barr (1997) has pointed out that if *D. tasmanicum* is "congeneric with the type species of *Maireella* [H. Sydow in Maire (1908)] then *Dimerium* would provide the earlier generic name for species assigned to *Maireella* and its synonym *Winteromyces* Speg. [1912]". Barr stated further that *Maireella* is substantially different from *Gibbera* Fr. where Müller and Arx (1962) had placed it as a synonym.

From Hansford's redescription of the holotype of *Dimerium tasmanicum* it seems most unlikely that the teleomorphs of the two *Heterosporiopsis* taxa are congeneric with this species. For example, Hansford found no trace of a double wall in the asci of *D. tasmanicum* and the ectostroma contained multiloculate stromata with uniloculate perithecia around the edge of the ectostroma.

Petrak (1950) placed *Dimerosporium moniliferum* in *Periline* H. Sydow (1939), type species *P. monninae* (Pat.) H. Syd. (Syn. *Dimerosporium monninae* Pat. in Patouillard & Lagerheim 1892). In his revision of *Dimerosporium*, Theissen (1912) transferred *D. monninae* Pat. to *Gaillardielia* Pat., type species *G. pezizoides* Pat. The latter genus is currently included in the family Nitschkiaceae (Hawksworth & al. 1995). The DAOM isotype of *Periline monninae*

(Rehm's Ascomyceten 1096 sub *Dimerosporium monninae*) has asci, ascospores and a hamathecium of pseudoparaphyses similar to those of *D. moniliferum* but a subcuticular dendritic hyphal plate is absent and the superficial hyphae bear no anamorph. *Periline* is accordingly regarded as an unsuitable disposition for *Dimerosporium moniliferum* and *Dimerium olivaceum*.

*Botryostroma monninae* Batista & Barreto in Batista & da Silva Maia (1960) is based on an isotype collection of *Dimerosporium monninae* Pat. and is clearly a synonym of this name. The type species of *Botryostroma*, *B. inaequalis* (Wint.) Höhnelt, and the second species, *B. eupatorii* (Stev.) Müller & von Arx, have 1-septate ascospores with the lower cell inordinately short; hyphae are subcuticular and intraepidermal, superficial hyphae are apparently absent, and no anamorph has been reported. *Botryostroma* is also an unsuitable generic disposition for '*B. monninae*' as well as for *Dimerosporium moniliferum* and *D. olivaceum*.

Müller (in Müller & von Arx, 1962) included both *D. moniliferum* and *D. monninae* as species of *Antennularia* Reichenbach with *Periline* as a generic synonym. Barr (1968) noted that "*Periline* Syd. differs from *Antennularia* only in possessing a light-coloured hypostroma (Müller & von Arx, 1962), a characteristic not sufficient to distinguish two genera". However, the type of *Antennularia* which is based on "*Antennularia ericophila* Link", has been considered to be of uncertain application by Hughes (1970), Sivanesan (1974) and Barr (1971), and was accepted as such by Hawksworth et al. (1995).

Barr (1971) used *Protoventuria* Berl. & Sacc. [type species *P. rosae* (de Not.) Berl. & Sacc. syn. *Antennularia rosae* (de Not.) Müller] as a replacement generic name for *Antennularia* and made several transfers of epithets in *Antennularia* to *Protoventuria*. Sivanesan (1974) made additional transfers and included *Dimerosporium moniliferum* and *D. monninae* in *Protoventuria*.

*Protoventuria rosae* (De Not.) Berl. & Sacc., the type of this genus, has superficial hyphae that penetrate the cuticle and epidermal cells to produce a stromatic zone (Müller & Menon, 1955). Perithecia bear numerous black, stiff setae and ascospores are deep brown. No anamorph was described for this species by Müller & Menon (1955) or by any other author except Müller & von Arx (1962). These authors noted that Petrak (1950) had referred the anamorph of *Dimerosporium moniliferum* (syn. *Antennularia monilifera* (Pat.) Müller) to *Heterosporiopsis* and added that there is no doubt that this conidial fungus is similar to that of *Antennularia rosea* (de Not.) Müller. Such conidia were described on short conidiophores on superficial stromata, 3- to 5-septate with a single longitudinal septum in one of the cells and  $13-18 \times 5-6 \mu\text{m}$ . No such conidia have been seen in the single specimen (DAOM 92009), from Switzerland,

identified as *A. rosea* by Dr. Müller. Also, no such conidia are present on two preparations (preserved in DAOM) made by Wehmeyer from parts of the holotype preserved in RO (Rome, Italy) and in Berkeley's herbarium in K (Kew, U. K.)

For these reasons, *Protoventuria* is considered an unsuitable disposition for the teleomorphs of the two species of *Heterosporiopsis*.

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