

Bertia moriformis and its varieties

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Examination of Canadian, United States, and European collections of Bertia moriformis in DAO, TRTC, and other herbaria revealed the existence of two distinct forms distinguished solely by differences in ascospore morphology and dimensions. Bertia moriformis var. moriformis occurs mostly on deciduous wood in Europe and North America and is characterized by narrow, uniseriate, straight to gently curved ascospores, 4.5–6.5 \( \mu \)m wide. Bertia moriformis var. latispora, described as new, occurs principally on coniferous wood; the collections with one exception are from North America. Within the ascus, the ascospores of var. latispora are indistinguishable from those of var. moriformis, but when mature and free of the ascus, they are wider, 6–8.5 \( \mu \)m, and geniculate. Germinating ascospores of var. latispora apparently become plurisepitate prior to germination. Bertia moriformis var. multisepitata Sivanesan, with multisepitate ascospores, is briefly redescribed and illustrated.


L’examen de spécimens canadiens, américains et européens de Bertia moriformis provenant des herbaries DAO, TRTC, et autres a révélé qu’il existe deux formes distinctes qui se caractérisent uniquement par des différences dans la morphologie et les dimensions des ascospores. Bertia moriformis var. moriformis se retrouve surtout sur des espèces ligneuses décidues en Europe et en Amérique du Nord; elle se caractérise par des ascospores minces, simplement septées, droites à légèrement courbées, mesurant 4.5–6.5 \( \mu \)m en largeur. Bertia moriformis var. latispora, décrite comme nouvelle variété, se retrouve surtout sur les conifères; sauf une exception, toutes les collections sont d’Amérique du Nord. À l’intérieur de l’ascus, les ascospores du var. latispora ne peuvent être distinguées de celles du var. moriformis, mais lorsqu’elles sont mûres et libres de l’ascus, elles sont plus larges, 6–8.5 \( \mu \)m, et géniculées. Les spores du var. latispora deviennent apparentement plurisepitates avant la germination. On trouvera également une redescription avec illustrations de Bertia moriformis var. multisepitata Sivanesan.

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Introduction

An examination of Canadian specimens filed as Bertia moriformis (Tode: Fr.) de Notaris at the National Mycological Herbarium (DAO, Agriculture Canada, Ottawa, and at the cryptogamic herbarium of the Department of Botany, University of Toronto (TRTC), revealed that there are two distinct populations that can be readily distinguished by the shape and dimensions of mature ascospores. Differences in ascomatal morphology could not be discerned, but a minor difference in ascus width was apparent. Immature ascospores of both forms are identical while within the ascus. Only after the asci have disintegrated and the free ascospores have reached maturity within the centrum can the varieties be distinguished. Bertia moriformis var. latispora var. nov. is described therefore on the basis of its distinct ascospores.

Additional collections of Bertia moriformis from the United States and from Europe were examined to determine the range of the new variety. Bertia moriformis var. multisepitata Sivanesan is briefly redescribed and illustrated from the type collection and one additional gathering.

Taxonomy

Bertia moriformis (Tode: Fr.) de Notaris var. moriformis, G. Bot. Ital. 1: 335. 1884 Figs. 1, 2, 6, 7, 11–13
=Sphaeria claviformis Sowerby, Col. Fig. Engl. Fungi, plate 337. 1801
=Sphaeria rubiformis Sow., Col. Fig. Engl. Fungi, plate 373, Fig. 2. 1802
=Sphaeria rugosa Greville, Flora edensis, p. 364. 1824

Ascomata scattered to gregarious, superficial on sound or, occasionally, on partially rotted wood, infrequently erumpent through attached bark of dead wood, subiculum lacking, attached to substrate by a few dark brown hymal strands, black, short cylindrical, 700–1000 (−1200) \( \mu \)m high (including the base), 500–700 \( \mu \)m wide; upper fertile portion of ascoma globose to subglobose, coarsely turbinate and borne on a well-developed, short cylindrical, nontuberculate base. "Ostiole" not recognizable externally but in median longitudinal section seen as an apical thinning of the ascoma wall; the underlying area filled with thin-walled hyaline cells which disintegrate early, and eventually, the overlying wall cells lysing. Ascoma wall at the top and sides unevenly thickened owing to the presence of the tubercules, composed of dark brown to blackish (at the periphery), thick-walled, angular to tangentially flattened cells up to 30 \( \mu \)m in length, consisting of 8–10 cell layers, 70–100 \( \mu \)m thick, between the tubercules and 10–15 cell layers, 100–125 \( \mu \)m thick, through the tubercules; walls of adjoining cells possessing prominent pores (Munk pores), ca. 1 \( \mu \)m diam., each bordered by a doughnut-shaped thickening; innermost zone bordering the centrum consisting initially of 4–6 layers of pale to hyaline tangentially flattened cells. Ascii arising from a basal cushion of thin-walled angular cells, unitunicate, clavate, long stipitate, thin walled, 92–140 × 10–21 \( \mu \)m (including the stalk), 8 spored, deliquescing early and liberating ascospores into centrum. Ascospores irregularly arranged in upper portion of ascus, hyaline, fusiform, 34.5–52.5 × 4.5–6.5 \( \mu \)m, straight to curved, ends rounded to acute, 1 (−3) septate, guttulate, smooth.

SUBSTRATE: Decorticated sound wood, occasionally on partially rotted wood and dead branches of living trees and shrubs,
Fig. 1. Bertia moriformis var. moriformis. Vertical section through ascoma, scale 500 μm; ascus, scale 50 μm, DAOM 37419.

mostly on deciduous wood (Acer, Alnus, Betula, Corylus, Fagus, Fraxinus, Populus, Quercus, Rhododendron, Salix, Sambucus, Tilia), occasionally on coniferous wood (Abies, Picea, Pinus), and occasionally on old basidiocarps (Coriolus, Hirschioperus).


Fig. 3. *Bertia moriformis* var. *latispora*. Ascospores: (A) immature from ascus; (B) immature, free in centrum; (C) mature, one septate; (D) multi-septate with phialidic germination; scale 10 μm, DAOM 59880 (holotype).

Pen-y-clawdd Woods, BPI ex IMI (9933), 13 April 1945, S.J.H., dead wood.

Approximately one-half of the Canadian collections of *Bertia moriformis* examined and about two-thirds of the smaller sampling of U.S. collections (mostly from the northeast) are variety *moriformis*. The type variety is distributed from the east coast to the west coast in Canada and probably occurs in all provinces, although a few are not represented by collections in DAOM and TRTC. All but three of the over 40 European collections examined are variety *moriformis*.

Normally the ascospores of variety *moriformis* are one septate, occasionally up to three septate. However, two collections, TRTC 10709 (at G, but not the part at TRTC) and a Farlow collection from Chester, PA (ex herb. Ellis, coll. 1891), had a few plurisepetate ascospores indistinguishable from the three- to eight-septate ascospores of *Bertia moriformis* var. *multisepitata* Sivanesan.

*Bertia moriformis* (Tode: Fr.) de Not. var. *latispora* var. nov.

Figs. 3, 4, 8, 9, 14

Ascomata dispersa aut aggregata, superficialia aut interdum partim immersa, nigra, breviter cylindracea, 750–1000 × 525–750 μm magna, summa in parte globosa vel subglobosa, tuberculata, basin versus breviter cylindracea; peridium e cellulis angularis, porosis compositum. Asci unitunicati, clavati, basin versus in stimitem longum attenuati, cum parietibus tenuibus, (100–)120–150 × 15–25 μm magni, octospori, evanescenti. Ascosporae hyalinae, primum fusiformes, maturitate confirmata, 30–49 × 6–8.5(–10.5) μm magnae, inferne in parte geniculatae, 1(–3) septatae.

**HOLOTYPUS:** In ligno pini lectus est, in loco Gatineau Park vocato, in Gatineau comitatu, in Quebec provincia Canadensis

Fig. 4. *Bertia moriformis* var. *latispora* (multi-septate form). Ascospores, scale 10 μm, TRTC 22926 (DAOM 187155).
ETYMOLOGY: Latin, latus = broad and spuria = seed, referring to the wider ascospores.

Ascomata scattered or gregarious, superficial or occasionally erumpent, on hard or partially rotted wood, black, short cylindrical, large, 700–1000 × 500–700 μm, in the upper portion globose to subglobose, tuberculate, borne on a short cylindrical base. Ascoma wall composed of angular to tangentially flattened cells, with prominent pores in adjacent walls. Asci unistiate, clavate, long stipitate, thin walled, (100–)120–150 × 15–25 μm, 8 spored, deliquescing early and liberating ascospores into centrum. Ascospores irregularly arranged in upper portion of ascus, hyaline, initially fusiform, at maturity 30–49 × 6–8.5(–10.5) μm, usually geniculate in the lower half, 1–3 septate, guttulate, wall smooth.

SUBSTRATE: Decorticated sound wood, occasionally partially rotted wood and dead branches of living trees, mostly on coniferous wood (Abies, Picea, Pinus, Tsuga), occasionally on deciduous wood (Acer, Alnus, Salix), and occasionally on old basidiocarps (Hymenochaete).


Approximately one-half of the Canadian collections of Bertia moriformis and about one-third of the smaller sample of United States collections examined are variety latispora. Most of the latispora collections are from the eastern half of North America with the exception of two (out of 11) collections from British Columbia, Canada, and one from Colorado, U.S.A. The apparent scarcity of variety latispora from the west may in part be due to the smaller numbers of western North American collections available for study. Only 1 of the more than 40 European collections examined was variety latispora. European material was predominantly variety moriformis. Two collections from herb. IMI, one of these the type collections, were Bertia moriformis var. multiseptata.

Bertia moriformis var. latispora is characterized by its noticeably broader (6–8.5 μm) and geniculate ascospores in contrast to the narrower (4.5–6.5 μm) and straight to gently curved ascospores of the type variety. Differences in ascomatal morphology at the varietal level could not be discerned. The asci of variety latispora may be a little wider, although ascospores in the asci are not noticeably broader than comparable ascospores of variety moriformis. It is only after the ascospores of variety latispora have been liberated into the centrum that they mature and taken on their wider geniculate appearance. Immature ascospores of variety latispora (Figs. 3, A and B, and 14) are indistinguishable from mature ascospores of the type variety. When crush mounts containing mature ascospores are examined, it is immediately possible to recognize to which of the two varieties a collection belongs.

While variety latispora normally has 1-septate ascospores with occasionally up to 3 septa, one collection (TRTC 22926) has plurisepate but otherwise latispora-like ascospores (Fig. 4). Initially we had intended to erect a new variety of Bertia moriformis for this collection, considering it to be the plurisepate form of variety latispora just as Bertia moriformis
Bertia moriformis var. multiseptata Sivanesan was described by Sivanesan for IMI 214143, a collection bearing initially 1-septate (rarely 3-septate) ascosporas which at maturity became 3 to 8 septate and germinated either by phialides or by germ tubes (hyphal primordia). It appears (Sivanesan 1978, Fig. 14) that most or all of the cells of the purisepate ascosporas have the potential to germinate. In Fig. 14, a 1-septate ascosporas is also seen to have germinated from one cell. Previously Hawley (1923) reported on collections of B. moriformis from Mulgrave Woods, Yorkshire, England, which likewise were initially 1-septate, eventually became 3 to 7 septate at maturity and were 48 × 52 × 5–6 μm. Some ascosporas from the Mulgrave Woods specimens germinated from every cell. Hawley noted that the multiseptate ascosporas tended to be larger (up to 52 μm long) than the typical 1-septate ascosporas (up to 46 μm long) and he believed that multiseptate spores probably represent the mature condition of B. moriformis. Sivanesan on the other hand emphasized that multiseptation had been observed in no more than several mature collections and because of its rare occurrence he considered the multiseptate condition to represent a distinct variety of B. moriformis.

Discussion

Bertia moriformis is the type of the genus Bertia and is included in the Coronophorales, an order erected by Nanfeldt (1932, p. 54) for certain wood-inhabiting and mycoparasitic Ascomycetes possessing dark coriaceous ascomata and long-stalked, deliquescent asci. Nanfeldt’s Coronophorales included two families, the Coronophoraceae v. Hohn. (1907) and the Nitschkiaceae (Fitzp.) Nannf. (1932), and was originally considered by him to be far removed from other major taxa of ununicinate Ascomycetes. Müller and von Arx (1973) grouped the genera in a single family, the Coronophoraceae. Nanfeldt’s recent reevaluation of the order (1975) concluded that a revised Coronophorales is a distinctive but homogeneous group derived from the Lasiosphaeriaceae Nannf. sensu Lundq. (1972). Nanfeldt (1975) recommended that the Coronophorales be abandoned as a separate order and the genera be united in the single family Nitschkiaceae near the Lasiosphaeriaceae. He also referred to the problem of the correct family name (p. 304). The name Coronophorales has priority if the “Familie der Coronophoreen” v. Höhnel (1907) is to be accepted. Eriksson (1982), however, considers the name to be illegitimate (International Code of Botanical Nomenclature, article 18). von Arx (1981) likewise considers this group to be closely related to the Lasiosphaeriaceae but has continued until quite recently to accept Coronophoraceae as the family name.

Recognizing the distinctiveness of Bertia within the Coronophorales, Smyk (1981) erected the family Bertiaceae for Bertia moriformis. Curiously, Smyk’s illustrations of the perithecia and ascosporas of B. moriformis are not of this species. Bertia moriformis is a true member of the Nitschkiaceae.
Figs. 6–10. Vertical sections through ascomata. ×120. Figs. 6 and 7. Bertia moriformis var. moriformis, DAOM 37419. Fig. 8. B. moriformis var. latispora, DAOM 59880 (holotype). Fig. 9. B. moriformis var. latispora (multiseptate form), TRTC 22926 (DAOM 187155). Fig. 10. B. moriformis var. multiseptata, IMI 214143 (holotype).
(sensu Nannfeldt 1975), but it occupies a solitary position within the family. *Bertia* may be monotypic. Although several species have been placed in the genus *Bertia*, three examined by Nannfeldt (1975) were found not to be congeneric.

We conclude that the subspecific taxa described in *Bertia moriformis* are distinguishable only by differences in the morphology of their mature ascospores. Varieties *moriformis* and *latispora* do exhibit host or substrate preference, but this distinction is not sufficiently constant to be a reliable taxonomic character. In all other aspects of their morphology, the varieties of *B. moriformis* are indistinguishable. Because of the paucity of distinguishing characters, we believe that these taxa do not warrant recognition at the specific level.

*Bertia moriformis* var. *moriformis* occurs principally on deciduous wood, although sometimes it is on coniferous wood. It is characterized by hyaline, narrow, 1-septate, straight to gently curved ascospores, 4.5–6.5 μm wide. *Bertia moriformis* var. *latispora* is found mainly on coniferous wood and sometimes on deciduous wood. The young ascospores of variety *latispora* are like variety *moriformis* in the ascus, but at maturity (free in the centrum) they are wider, 6–8.5 μm, and geniculate usually below the middle.

With some reservation, we accept variety *multisepitata* as a distinct variety. As Sivanesan (1978) pointed out, plurisepitate ascospores have been observed in only a few collections. He may be quite correct in his assumption that the plurisepitate condition of the ascospores, because of its rarity, is a reliable taxonomic character at the varietal level. However, our observation of some plurisepitate ascospores in two collections of variety *latispora*, which like the type variety are 1-septate, suggests that plurisepitation may be the natural condition at ascospore maturity just prior to ascospore germination. An investigation of ascospore germination *in vitro* of 1-septate variety *moriformis* ascospores might clarify the situation.

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