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Emendation of Geosiphonaceae and *Geosiphon pyriformis*

Geosiphonaceae Engler and Gilg, 1924 (Syllabus der Pflanzenfamilien, Verlag von Gebrüder Borntraeger, Berlin, page 24), emend. Schüßler

Fungi with coenocytic mycelium, when senescent or dead sparsely septate hyphae occur; living mostly hypogeously. Forming asexual spores with a rigid, chitinous structural wall by blastic development of hyphal tip or intercalarly, followed by thickening of structural wall components. Spores globose to subglobose, produced singly or in loose clusters, occurring in soil. Fungi, as far known, biotrophic, forming close symbiotic relationship with photoautotrophic organisms. Presently one species known which produces endocytosymbioses with cyanobacteria. Phylogenetically belonging to an order (Archaeosporales) of the arbuscular mycorrhizal and related fungi (phylum Glomeromycota Walker and Schüßler; class Glomeromycetes Cavalier-Smith). Phylogenetic sequence analyses were described in detail in Schüßler et al. (2001a; Mycol. Res. 105, 5–15), Schüßler et al. (2001b; Mycol. Res. 105, 1413–1421), and Schwarzott et al. (2001; Mol. Phylogenet. Evol. 21, 190–197). Presently containing one species, *Geosiphon pyriformis*.

Genus typicum: *Geosiphon pyriformis* F. von Wettstein, 1915 (Österreichische Bot. Z. 65, 145-156) = *Botrydium pyriforme* Kützing 1849 (Species algarum. Lipsiae, Leipzig, p. 486)

Geosiphon pyriformis (Kützing) F. von Wettstein, 1915 (Österreichische Botanische Zeitschrift 65: 145–156), emend. Schüßler

Fungus mostly hypogeous; symbiotic saccules (‘bladders’) epigaeous. Mycelium coenocytic, or sparsely septate when senescent. As far as known, biotrophic, forming close symbiotic relationship with photoautotrophic organisms. Known to produce endocytosymbioses with cyanobacteria (*Nostoc* sp.). Further bacterial endosymbionts living in the fungal cytoplasm, about 0.5 *µ*m in diameter and ovoid, frequently with a median constriction. Fungus phylogenetically belonging to a taxon at the level of order (Archaeosporales) of the arbuscular mycorrhizal and related fungi (phylum GlomeromycotaWalker and Schüßler; class Glomeromycetes Cavalier-Smith). Forming white to slightly brownish chlamydospores, produced singly or in loose clusters, occurring in soil. Spore wall structure of a rigid, chitinous structural wall. Spores formed by blastic development of hyphal tip or, less frequently, intercalarly, followed by thickening of structural wall components. Wall of the spores consists of a thin, flexible innermost layer, a laminated layer with a thickness of 10–13 *µ*m, and an irregularly shaped evanescent outer layer, extending for some micrometers along the subtending hypha, sometimes lacking on mature spores. Electron microscopic observations show that the laminated layer comprises helicoidally arranged microfibrils and is separated from the evanescent outer layer by a thin (about 0.2 *µ*m) sublayer. Innermost layer about 0.4 *µ*m thick, delimited against the inner wall layer by a thin sublayer. Occlusion of subtending hypha by formation of an amorphous plug comprising thin, septum-like structures in the lumen of the subtending (sporogenous) hypha. Plug draws through the laminated wall of the spore, within the hypha often ends at a thick septum. Mature spores formed in laboratory cultures on fine sand are globose (diameter 160–320 *µ*m; mean 253 *µ*m, SD = 24 *µ*m, *n* = 166 spores; >93% of the spore diameters between 220–300 *µ*m). Spores in coarse substrate tend to be more ovoid to irregular in shape. Spores contain many lipid droplets of different size (up to 20 *µ*m in diameter) and ‘structured globules’ (SGs, diameter 3–6 *µ*m). The latter consist of a highly light-refracting, homogenous outer and a granular interior part. They swell within a few minutes after they have been released in water by squeezing the spore. Electron microscopy shows the SGs to contain slightly bent rods in paracrystalline arrays. The rods have a diameter of about 6 nm, are packed hexagonally with a center to center spacing of about 8 nm. Germination occurs through the subtending hypha or directly through the spore wall, by one or several germination hyphae.A ‘cytoplasmic pole’, free of SGs and big lipid droplets, often is visible at the location of hyphal outgrowth. For further details of spore characters, see Schüßler et al. (1994; Bot. Acta 107, 36–45). Characters of symbiotic interface and compartmentation were described in detail in Schüßler et al. (1996; Protoplasma 190, 53–67). Phylogenetic sequence analyses were described in detail in Schüßler et al. (2001a; Mycol. Res. 105, 5–15), Schüßler et al. (2001b; Mycol. Res. 105, 1413–1421), and Schwarzott et al. (2001; Mol. Phylogenet. Evol. 21, 190–197).

Etymology:

Genus: Greek: *ge*, soil; *sipho*, *siphonis*, tube; SPECIES: Latin: *pírus*, *pýrus*, pear; *fórmis*, shaped – referring to the syncytial mycelium and the tube-like, pear shaped appearance of the unicellular bladders formed by this fungus, containing the endosymbiotic cyanobacteria.