

Overview of the genus *Claussenomyces* and a description of Italian collections

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The author reports briefly on the genus *Claussenomyces* Kirschst. and two Italian species collected to date. In addition, remarks, a comparison with similar entities, pencil-drawings, and a dichotomic key are given.

Key words: Ascomycotina, *Helotiales*, *Helotiaceae*, *Claussenomyces*

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Autor stručně charakterizuje rod *Claussenomyces* Kirschst. a popisuje dosavadní dva sběry z Itálie s poznámkami, kresbami a srovnáním podobných druhů. Je připojen dichotomický klíč k určování druhů tohoto rodu.

INTRODUCTION

Morphoanatomic characters of the genus *Claussenomyces*

Apothecia turbinate, pulvinate, slightly longitudinally prolonged, at times almost lens-shaped, sessile or sub-stalked, up to 0.6 mm in diameter, 0.6 mm high, growing in groups of more or less numerous ascocarps, rarely singly; in some cases fixed to the substratum by a scarce, anchoring subiculum. Hymenium generally greenish white to blackish green, in some cases reddish brown. Outer surface smooth, concolorous with the hymenium; margin regular. Flesh jelly and elastic, more or less deep greenish or brownish. In some species apothecia are found together with their conidial stages, showing more or less clavate and concolorous fruitbodies, up to 0.7 mm high, named *Dendrostilbella* [*C. prasinulus* (P. Karst.) Korf et Abawi, a European species, and *C. pini* A. Funk, an exotic species]; in other cases [*C. pleomorphicus* Gamundí et Gaiotti and *C. pseudotsugae* (J.W. Groves) Ouell. et Piroz., both of them exotic] a pycnidial anamorph may be noted, and finally, e.g. in *C. atrovirens* (Pers.: Fr.) Korf et Abawi, a European species, the conidial stage is lacking.

Ascospores fusiform or subcylindrical, sometimes slightly curved, with 3-16(-21) more or less marked transversal septa and sometimes one or more longitudinal ones, smooth, hyaline, irregularly arranged in the ascus; in some cases they may divide into rounded or prolonged secondary spores. Asci normally clavate, inoperculate, 8-spored, amyloid or non-amyloid, originating from croziers. Paraphyses cylindrical, enlarged and forked in the upper part, or slender, often branched, as long as the asci; in some cases an amorphous, dark matter surrounding the apex is notable (epithecium). Excipulum made up of two layers: a gelatinised ectal excipulum of a *textura oblita-intricata*; a medullary excipulum of a *textura intricata* immersed in a jelly matrix, occasionally with greenish or brownish pigments and with globose cells up to 12 µm in diameter.

Habitat: on decaying and decorticated deciduous or coniferous wood, on cones or resinous exudates; fructifying all year, but mainly in autumn.

Distribution of species of the genus *Claussenomyces*

Some *Claussenomyces* species are widespread over various continents and in every type of climate; in the literature, collections from Australia and Argentina (Gamundí and Giaioti 1995), North America (Medel et al. 1999, Funk 1986) and Europe (Dennis 1956, Dissing in Hansen and Knudsen 2000, Breitenbach and Kränzlin 1984) are indeed reported, growing on various kinds of decaying wood or on other vegetal debris, sometimes of exotic trees. The two collections here described were observed for the first time by Medardi (2006) and, to date, they are the only reports from Italy; however, because a lot of non-native plants are often imported for ornamental aims, the presence of other species related with them cannot be excluded.

Useful characters

The delimitation of the genus *Claussenomyces* is rather easy. It belongs to the *Helotiaceae* with jelly-elastic flesh, and just the tinges are sometimes enough to select some species, e.g. divide those with more or less dark reddish brown apothecia from those with relatively deep green or greenish ones, and so obtain two groups of them. Within each group it is then possible to see some microscopical differences, noting that species with green or greenish tinges have shorter ascospores (not over 28 µm long), contained in inamyloid asci, while those with more or less reddish brown ascocarps form longer ascospores (up to 150 µm long) in amyloid asci. Production of secondary spores, common also in species belonging to other genera (see following paragraph), cannot be related to the fruitbody colours. Neither the number of the septa is a significant feature, because sometimes shorter ascospores have more septa than longer ones.

Finally, habitat is essential in only one case, *Claussenomyces olivaceus* (Fuckel) Sherwood, living on resinous exudates of *Picea*, because the other species are able to grow on a range of rotten wood, both of conifers and of deciduous trees. The following synoptic key resumes the main characteristics of the *Claussenomyces* species considered in this work.

	Characteristic	<i>C. atrovirens</i>	<i>C. canariensis</i>	<i>C. clavatus</i>	<i>C. dacrymyceloides</i>	<i>C. jabianus</i>	<i>C. olivaceus</i>	<i>C. prasinulus</i>	<i>C. pusillus</i>
Fruitbody colour	Pale or dark green	x			x		x	x	
	More or less deep reddish brown		x	x		x			x
Ascospores	Up to 16 µm long							x	
	Up to 21 µm long	x			x				
	Up to 25 µm long			x					
	Up to 26 µm long		x						
	Up to 28 µm long						x		
	Up to 78 µm long								x
	Up to 120 (150) µm long					x			
	On average up to 3 transversal septa							x	
	On average up to 7 transversal septa					x	x		
	On average up to 10 transversal septa			x					
	On average up to 11 transversal septa	x							
	On average up to 13 transversal septa		x						
	On average up to 15 transversal septa								x
	On average up to 16 (21) transversal septa				x				
Fragmenting into secondary spores	x	x		x		x			
Asci	Amyloid		x	x		x			x
	Inamyloid	x			x		x	x	

Relationship with similar genera

A tough or more or less elastic consistency of the flesh, principally due to the presence of a variable quantity of gelatinised hyphae or jelly matter, is common also in some other genera, not always belonging to the same group. Some of them can with no trouble be divided from *Claussenomyces* according to shape, dimensions and colours of the apothecia, and by microscopical features, which are sometimes totally dissimilar: a number of them are stalked and up to tens of mm high, such as *Leotia* Pers. (*Leotiales*, *Leotiaceae*), with the hymenium placed on a “head” clearly differentiated from the stalk, and *Cudoniella* Sacc. (*Helotiales*, *Helotiaceae*), having

instead a nail-shaped apothecium, with the hymenium seated on its upper part. Some other representatives with elastic consistency are sessile or subsessile, and are about 25–30 mm in diameter, e. g. *Ascocoryne* J. W. Groves et Wilson, with turbinate, purple-violaceous ascocarps, and *Ascotremella* Seaver (both belonging to *Helotiales*, *Helotiaceae*), having more or less brain-shaped, brownish purple fruitbodies, *Bulgaria* Fr.: Fr. (*Helotiales*, *Bulgariaceae*), with turbinate or cup-shaped and entirely blackish brown fruitbodies, and *Neobulgaria* Petr. (*Leotiales*, *Leotiaceae*), also with turbinate or cup-shaped fruitbodies, but whitish–violaceous in colour.

Also in other genera belonging to *Helotiaceae* there are species with fruitbodies comparably shaped and dimensioned to those of *Claussenomyces*. In some cases they are concolorous, such as in *Gorgoniceps viridula* Huhtinen et Iturriaga, with discoid-pulvinate, greenish but basically brown apothecia, having waxy-elastic flesh and cylindrical or thread-shaped ascospores, $48\text{--}75 \times 2\text{--}2.5 \mu\text{m}$, normally with 7 transversal septa; in other cases the distinction is instead favoured by the different colours besides the microscopical features, as in *Cenangium* Fr.: Fr., with ascocarps mostly yellowish ochraceous, *Crumenulopsis* J. W. Groves, *Godronia* Moug. et Lév., *Gremmeniella* M. Morelet and *Tympanis* Tode: Fr., with black or blackish brown apothecia, and *Ombrophila* Fr., violaceous rosy or violaceous hazelnut.

Fragmentation of the initial ascospores into secondary ones is notable in at least two other genera of the *Helotiaceae* (*Tympanis* and *Gremmeniella*), and thus not typical; moreover it is noticeable only in some species of *Claussenomyces*. The table below summarises the principal features of the mentioned genera.

Genus	Ascocarp colour	Growth	Ascospores	Substrate
<i>Cenangium</i> Fr.: Fr.	Yellowish ochraceous	Gregarious	Elliptical	Wood or needles of conifers, deciduous wood
<i>Claussenomyces</i> Kirschst.	Whitish green to blackish green	Gregarious	Fusiform, subcylindrical, septate. Fragmentation into secondary spores inconstant	Wood or vegetal debris of conifers or deciduous trees
<i>Crumenulopsis</i> Groves	Grey or blackish	Gregarious	Fusiform	Wood of conifers
<i>Godronia</i> Moug. et Lév.	Hymenium pale, outside blackish brown	Gregarious	Fusiform-clavate, thread-shaped, septate	Decaying wood, sometimes leaves or fruits
<i>Gorgoniceps</i> P. Karst.	Greenish or whitish	Gregarious	Thread-shaped, curved, septate	Decaying wood
<i>Gremmeniella</i> M. Morelet	Blackish brown	Gregarious	Elliptical-clavate, septate, fragmenting into secondary spores	Wood of conifers (parasitic)
<i>Ombrophila</i> Fr.	Violaceous rosy or violaceous hazelnut	Gregarious	Elliptical	Vegetal debris
<i>Tympanis</i> Tode: Fr.	Blackish brown	Clustered	Globose or pear-shaped, ovoid, cylindrically curved, fragmenting into secondary spores	Decaying wood

MATERIALS AND METHODS

All the material was primarily analysed in fresh state in the field, in order to note true shape, dimensions and colours of the apothecia; microscopical examination was carried out also on fresh samples, employing water in order to appreciate the colours of fungal tissues, and Melzer's reagent or IKI (1 % iodine and 3 % KI in water) to verify the eventual amyloidity or hemiamyloidity of the asci.

Analyses of dried material were repeated to confirm some microscopical characters, preceded by a re-hydration in water, KOH (5 % concentrate) or a glycerochloridic solution (commercial concentration); it was executed with the same chemical substances as in the previous case, in addition using also Congo Red in order to mark some particulars, employing an optical microscope, with 40× or 100× (immersion oil) objectives; dimensions of the microscopic elements were obtained after 50 measurements in each collection, using water to mount the glasses.

Synonymy of the species is according to CABI's Index of Fungi (<http://www.indexfungorum.org/Names/names.asp>).

After the study, the samples were placed in the Herbarium of the Civic Museum of Natural History of Venice (Italy) [MCVE].

RESULTS

Claussenomyces atrovirens (Pers.: Fr.) Korf et Abawi, Can. J. Bot. 49(11): 1882 (1971) Fig. 1

Basionym: *Peziza atrovirens* Pers. 1801, Syn. meth. fung.: 635 (1801)
 = *Claussenomyces hydnicola* (Berk. et Broome) Korf et W. Y. Zhuang, Mycotaxon 29: 8 (1987)
 ≡ *Corynella atrovirens* (Pers.: Fr.) Boud., Hist. class. Discom. Eur.: 99 (1907)
 = *Helotium agaricinum* (Berk.) W. Phillips, Man. Brit. Discomyc.: 170 (1887)
 = *Mollisia hydnicola* (Berk. et Broome) W. Phillips, Man. Brit. Discomyc.: 194 (1887)
 = *Mollisiella hydnicola* (Berk. et Broome) Sacc. et D. Sacc., Syll. fung. 17: 64 (1905)
 ≡ *Ombrophila atrovirens* (Pers.: Fr.) W. Phillips, Man. Brit. Discomyc.: 325 (1887)
 = *Pseudohelotium hydnicola* (Berk. et Broome) Sacc., Syll. fung. 8: 304 (1889)

Apothecium rather variably shaped, globose, lens-shaped or urceolate, but sometimes cup-shaped, about 0.5 mm in diameter, sessile, located in groups of more or less numerous ascocarps in a scarce dark brown subiculum. Hymenium smooth, emerald-green, dark green, with more or less livid tinges. Outer surface smooth or minutely pruinose, concolorous. Margin regular, relatively undulate. Flesh rather tough, waxy-elastic, olivaceous green.

Ascospores clavate, 16–21 × 3–4 μm, smooth, hyaline, with 7–10 transversal septa (sometimes the separate cells show a longitudinal, more or less oblique,

sometimes forked septum), biseriate in the ascus, when mature fragmenting into secondary spores of $2\text{--}2.5 \times 1 \mu\text{m}$. Asci clavate, up to $120 \times 12 \mu\text{m}$, inamyloid, 8-spored to multi-spored by the sporal division, arising from croziers. Paraphyses cylindrical, slightly enlarged (up to $3 \mu\text{m}$) and forked in the upper part, where they contain greenish pigments. Subiculum made up of dark brown, septate hyphae, up to $3\text{--}4 \mu\text{m}$ wide. Excipulum characteristic of the genus.

Habitat: on deciduous or coniferous wood; winter-spring.

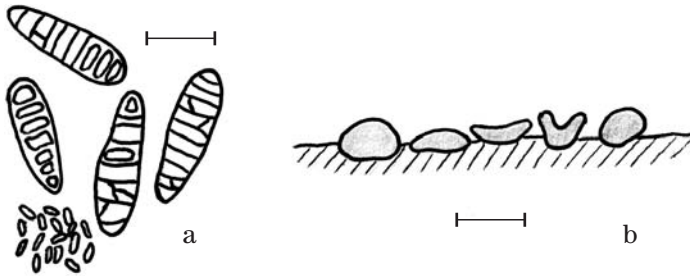


Fig. 1. *Claussenomyces atrovirens*, a – ascospores and secondary spores, bar = $10 \mu\text{m}$; b – silhouette of apothecia, bar = 0.5 mm .

Examined material: 12/02/95, Rezzato (Brescia), Italy, on dried, decorticated wood of *Erica* sp., fallen on the ground [MCVE Erb2. 11526], leg. et det. G. F. Medardi.

Iconography: Breitenbach and Kränzlin (1984), tab. 168; Medardi (2006), page 35.

Claussenomyces prasinulus (P. Karst.) Korf et Abawi, Can. J. Bot. 49: 1882 (1971) Fig. 2

Basionym: *Peziza prasinula* P. Karst., Monographia Pezizarum Fennicarum, Notis. Sällsk. Fauna

Flora Fennica Förhand. 10: 155, reprint: Collected Mycological Papers 1: 203–310 (1869)

= *Belonidium glabrovirens* (Boud.) Sacc., Syll. fung. 8: 498 (1889)

= *Corynella prasinula* (P. Karst.) Boud., Discom. d'Europe: 99 (1907)

Apothecium lens-shaped or pulvinate, about 0.5 mm in diameter, sessile, growing in groups. Hymenium smooth, very pallid greenish white, with pale yellowish tinges. Outer surface smooth, concolorous. Margin regular. Flesh waxy, but rather tough, whitish.

Ascospores cylindrical and more or less curved, $12\text{--}15\text{--}(16) \times 3\text{--}4 \mu\text{m}$, 3-septate when mature, smooth, hyaline, biseriate in the ascus, not fragmenting into secondary ones. Asci clavate, $70\text{--}80\text{--}(105) \times 8\text{--}10 \mu\text{m}$, inamyloid, 8-spored, arising from croziers. Paraphyses thread-shaped, up to $2 \mu\text{m}$ wide, often repeatedly branched, greenish, especially in the upper part. Excipulum characteristic of the genus.

Habitat: on decaying, humid and decorticated deciduous wood; summer-autumn.

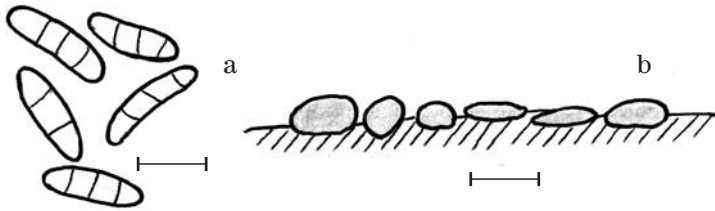


Fig. 2. *Claussenomyces prasinulus*, a – ascospores, bar = 10 μm ; b – silhouette of apothecia, bar = 0.5 mm.

Examined material: 18/10/00, Bondo (Trento), Italy, on decaying, humid wood of deciduous trees [MCVE Erb2. 15481], leg. et det. G. F. Medardi.

Iconography: Breitenbach and Kränzlin (1984), tab. 169.

DISCUSSION

The Italian species described in this work belong to the green or greenish species of *Claussenomyces*; however, they are different in coloration: the apothecia of *C. atrovirens* are dark green, while those of *C. prasinulus* are markedly paler, greenish white with yellowish tinges. Other differences have to be studied microscopically, particularly spores dimensions, number of transversal septa (see the descriptions), and presence of secondary spores (present in *C. atrovirens*, lacking in *C. prasinulus*).

Claussenomyces dacrymycetoideus Ouell. et Korf has a marked affinity with *C. atrovirens* in the dark green coloration of the apothecia, absence of secondary spores, inamyloidity of the asci, spores dimensions ($16\text{--}21 \times 2\text{--}3 \mu\text{m}$) and growth on decaying wood; the demarcation can in this case be entrusted to the number of transversal septa of the ascospores, 5–11 in *C. atrovirens*, less than in *C. dacrymycetoideus* [7–16(–21)].

C. olivaceus (Fuckel) Sherwood has likewise rather deep olivaceous green fruitbodies, but it can be easily discriminated from *C. atrovirens* and from *C. dacrymycetoideus* by its wider ascospores ($11\text{--}28 \times 3.5\text{--}7 \mu\text{m}$), with 7 septa when mature, and by its growth on resinous exudates of *Picea*.

Among the species with more or less dark red-brown apothecia, *C. jahnianus* Kirschst. is mainly notable by its very long and slender ascospores [$90\text{--}120\text{--}(150) \mu\text{m}$], having 7 transversal septa when completely mature and not fragmenting into secondary ones; it lives on dead *Quercus* wood. In this group, there is also another

lignicolous species forming very long ascospores, *C. pusillus* (Rehm) Korf et Abawi, with slender ascospores 38–78 µm long, with 15 transversal septa, not dividing into secondary ones.

C. clavatus Ouell. et Korf and *C. canariensis* Ouell. et Korf, also typical of rotten wood, have instead markedly shorter ascospores, but dimensionally largely overlapping, and so separable only by their maximum number of septa: 18–25 × 3.5–4 µm with 5–10 septa in the first, 16–26 × 3–4.5 µm with 6–13 septa in the second. These latter two species can be separated also because in *C. clavatus* the ascospores do not fragment into secondary ones.

Dichotomic key of the considered species

[The key is constructed by the author using data from the following publications: Dennis (1981), Ellis and Ellis (1985), Gamundí and Gaiotti (1995), Vesterholt and Dissing (2000), Vesterholt and Petersen (2001)].

- 1 Apothecia greenish or more or less deep green; asci inamyloid. On resinous exudates of conifers, or on decaying wood **2**
- 1 Apothecia more or less deep red-brown; asci amyloid. Exclusively lignicolous..... **5**
- 2 (1) Apothecia very pale greenish white with fair yellowish tinges; ascospores 12–15(–16) × 3–4 µm, with 3 transversal septa when mature, not dividing into secondary ones ***C. prasinulus***
- 2 Apothecia darker green; ascospores fragmenting **3**
- 3 (2) On resinous exudates of conifers. Apothecia deep olivaceous green; ascospores 11–28 × 3.5–7 µm, with 7 transversal septa when mature ..***C. olivaceus***
- 3 On decaying wood..... **4**
- 4 (3) Apothecia emerald-green or dark green, sometimes with livid tinges; ascospores 16–21 × 3–4 µm, with 5–11 transversal septa and, sometimes, with some cells divided by longitudinal or oblique ones ***C. atrovirens***
- 4 Apothecia dark olivaceous-green; ascospores 16–21 × 2–3 µm with 7–16(–21) transversal septa when aged ***C. dacrymycetoideus***
- 5 (1) Ascospores slender, nearly thread-shaped, at least 38 µm long, not fragmenting into secondary ones **6**
- 5 Ascospores more or less irregularly elliptical, not over 26 µm long, sometimes dividing..... **7**

- 6 (5) Ascospores 90–120(–150) μm long, with 7 transversal septa when mature
 *C. jahnianus*
- 6 Ascospores 38–78 μm long, with 15 transversal septa when older .. *C. pusillus*
- 7 (5) Ascospores 18–25 \times 3.5–4 μm , with 5–10 transversal septa when mature,
 not fragmenting into secondary ones *C. clavatus*
- 7 Ascospores 16–26 \times 3–4.5 μm , with 6–13 transversal septa, dividing into
 secondary ones *C. canariensis*

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