

First records of *Tricholoma bresadolanum* (Agaricales) in the Czech Republic

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The paper reports on the first collections of *Tricholoma bresadolanum* in the Czech Republic. The authors present a macro- and microscopic description based on a study of material collected at two localities in the Bohemian Karst Protected Landscape Area in Central Bohemia. The species was also documented from another two sites in Moravia. The characters distinguishing *T. bresadolanum* from similar species of the genus *Tricholoma* are discussed.

Key words: *Tricholomataceae*, description, ecology, Bohemia, Moravia.

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Článek informuje o prvních nálezech čirůvky Bresadolovy – *Tricholoma bresadolanum* v České republice. Autoři článku předkládají makroskopický a mikroskopický popis tohoto druhu založený na studiu materiálu sbíraného na dvou lokalitách na území CHKO Český kras ve středních Čechách. Další dvě lokality čirůvky Bresadolovy byly objeveny na Moravě. Jsou diskutovány znaky odlišující *T. bresadolanum* od podobných druhů rodu *Tricholoma*.

INTRODUCTION

In September 2010, during a regular mycological survey in Karlštejn National Nature Reserve (Bohemian Karst), the second author accompanied by Naďa Melichová found an interesting fungus which they had never seen before. It was a remarkable species of the genus *Tricholoma* with a greyish and slightly squamulose pileus and stipe, growing in a thermophilic oak forest on calcareous soil. After a detailed study, the fruitbodies were identified as *Tricholoma bresadolanum* Cléménçon. Later, in 2013 and 2014, the species was found at other localities, in the southern part of Bohemian Karst and at two sites in South Moravia.

Tricholoma bresadolanium (*Tricholomataceae*, *Agaricales*) is a rare fungus which had not been reported from the Czech Republic in the past. According to e.g. Christensen & Heilmann-Clausen (2013), this distinctly thermophilous species is apparently more widespread and locally common in the Mediterranean zone, whereas in northern Europe is only known from scattered localities.

The aim of this paper is to summarise information on all the collections of this species known to us from the Czech Republic to date, supplemented with an authentic description and colour photographs.

MATERIAL AND METHODS

Macroscopic characters were studied on fresh fruitbodies collected in the Bohemian Karst. Microscopic mounts were made from dried material in ammoniacal Congo Red and a 5% KOH solution and studied under an Olympus CX21 light microscope with an oil-immersion lens at a magnification of 1000 \times . Spore sizes of 30 randomly selected spores were measured (extremely large spores were omitted). Q_{av} is the average value of spore length and width ratio. The descriptive terminology was taken over from Knudsen & Vesterholt (2008).

Herbarium specimens have been deposited in the Mycological Department, National Museum, Prague (PRM), the Museum of South Bohemia, České Budějovice (CB), and in the personal herbaria of Daniel Dvořák and Jan Běřák. Abbreviations of public herbaria follow Thiers (on-line).

Data on geological conditions were acquired from maps and descriptions at www.geologicke-mapy.cz (Bokr on-line).

RESULTS

Tricholoma bresadolanium Cléménçon, Documents Mycologiques 7(27–28): 54, 1977 (originally published under the grammatically incorrect name “*T. bresadolianum*”) Figs. 1–11

Selected literature. Riva (2003), Christensen & Heilmann-Clausen (2013).

Selected illustrations. Marchand (1986), Dähncke (1993), Lucchini (1997), Courtecuisse & Duhem (2000), Lonati (2000), Galli (2003), Riva (2003), Cetto (2005), Boccardo et al. (2008), Eyssartier & Roux (2011), Ludwig (2012), Christensen & Heilmann-Clausen (2013), Kibby (2013), Hagara (2014) – colours a bit incorrect.

Macroscopic characters. Pileus 35–80(100) mm wide, at first paraboloid to campanulate (Figs. 4, 6), later convex to plane (Figs. 5, 6), sometimes with a wide, low, domed or flattened umbo (Figs. 2–3), at first whitish to pale grey, becoming ash-grey to brownish grey (Figs. 4, 6), sometimes partially darker

brownish in central part (Figs. 2, 3), radially fibrillose (Fig. 7) with small, concentrically arranged, appressed, grey to blackish squamules (Fig. 8). Lamellae rather broad, up to 11 mm high, moderately spaced to rather crowded, $L = 70\text{--}80$, $l = 2\text{--}3$, emarginate with decurrent tooth, watery white to greyish (Fig. 10), turning dark greyish to black, especially along the often serrulate edge (Fig. 9), sometimes with more or less conspicuous orange-pinkish tinge, or even covered with drops of the same colour. Stipe 50–100 × 10–20(25) mm, cylindrical or somewhat tapering towards base, at first white, later pale greyish to ash-grey over the entire length except for the ochre-brownish base (Figs. 3, 5, 6), with girdles of greyish, ash-grey to blackish scales (Figs. 4, 5, 9), staining reddish brown when bruised, often deeply submerged in the substrate (Fig. 2), sometimes with several stunted fruitbodies at base. Context very firm, fibrous in stipe, whitish to pale greyish (Figs. 3, 11), often with watery areas in pileus or stipe base, often with a small cavity in upper part (Fig. 11). Taste at first mild, becoming bitter and acrid, smell indistinct, earth-like.

Microscopic characters. Basidiospores $6\text{--}8.5 \times 4.7\text{--}6.7 \mu\text{m}$, $Q = 1.17\text{--}1.50$, $Q_{av} = 1.34$, broadly ellipsoid to obovoid or ellipsoid with sometimes straight adaxial side, with small but distinct hilar appendix, thin-walled, hyaline, mostly containing one large droplet. Basidia $36\text{--}52 \times 8\text{--}11 \mu\text{m}$, narrowly clavate, 4-spored. Basidioles similar to basidia, mostly shorter. Cheilocystidia present, hyaline and not very distinct in non-pigmented marginal part, in dark marginal parts mostly with brownish wall (over the entire length or only partially) and agglutinated with brown amorphous material, crowded, $24\text{--}74 \times 4\text{--}11 \mu\text{m}$, clavate to cylindrical and often flexuous, occasionally with septum. Hyphidia present, narrower than basidioles, their terminal elements $15\text{--}62 \times 4\text{--}6 \mu\text{m}$. Lamellar trama regular, consisting of parallel, up to $8 \mu\text{m}$ broad hyphae which are thicker in the middle. Pileipellis a cutis, at places with protruding clusters of hyphae forming the scales. Clamp connections absent.

Habitat. Our collections originate from oak-hornbeam and oak forests in thermophytic regions, forming ectomycorrhiza with *Quercus*. The fruitbodies occur in small groups, sometimes even in small clumps comprising two or three specimens. The geological subsoil of our localities mostly consists of alkaline bedrock: limestone with clay shale in the Bohemian Karst, metabasalt and sandstone with conglomerate in Moravia.

Material examined

Czech Republic. Bohemia. Karlštejn – Budňany (Central Bohemia, Hořovická pahorkatina hills, Bohemian Karst), Karlštejn National Nature Reserve, Dřínová hora hill, alt. 380 m, under *Quercus* and *Cornus mas* on limestone with clay shale, 9 Sept. 2010, leg. V. Janda & N. Melichová, det. V. Janda (CB 17102). – Liteň (Central Bohemia, Hořovická pahorkatina hills, Bohemian Karst), Mramor hill, alt. 410 m, under *Quercus* and *Carpinus* on limestone with shale, 20 Sept. 2013, leg.

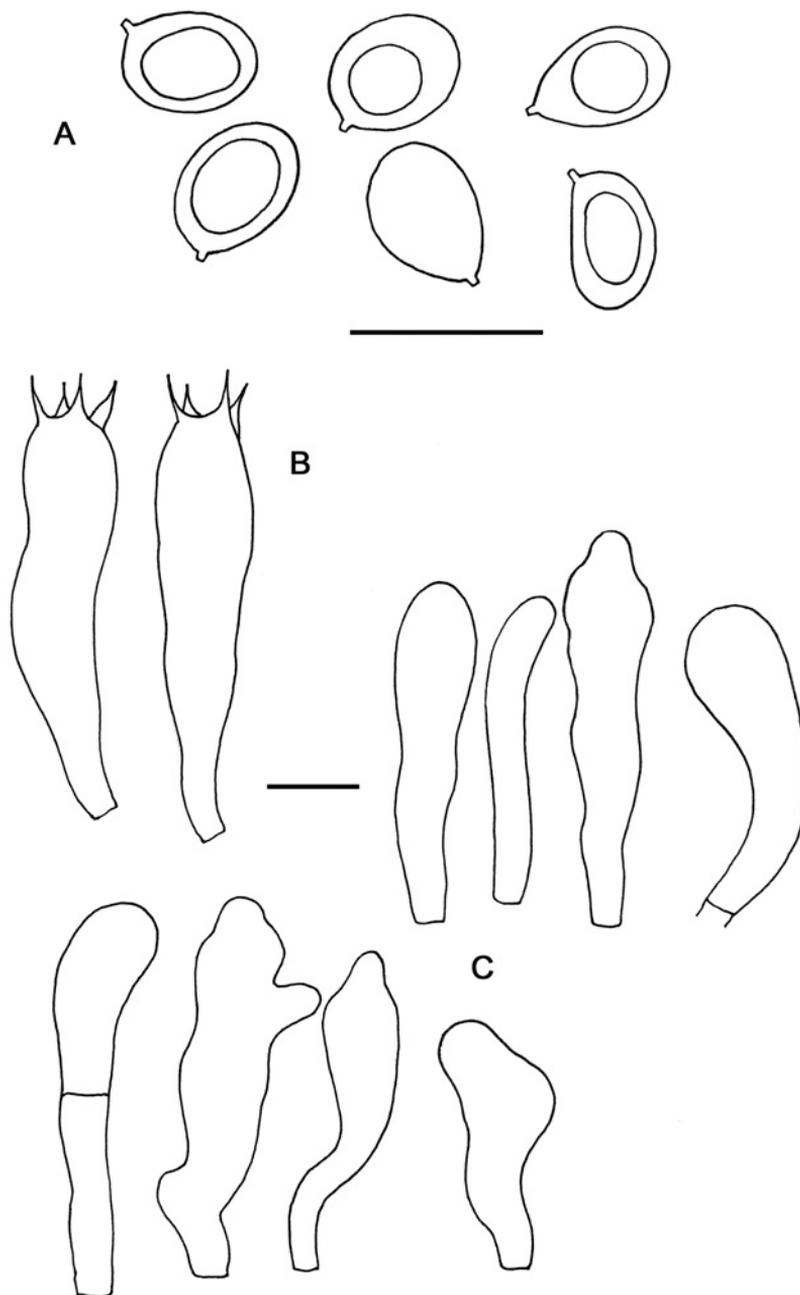


Fig. 1. *Tricholoma bresadolanum* (PRM 934107, PRM 934111). **A** – basidiospores, **B** – basidia, **C** – cheilocystidia. Scale bars = 10 μ m. Del. M. Kříž.



Fig. 2. *Tricholoma bresadolanum*, Dřínová hora hill, Karlštejn NNR, Bohemian Karst, Czech Republic, under *Quercus*, 9 Sept. 2010, leg. V. Janda & N. Melichová (CB 17102). Photo V. Janda.



Fig. 3. *Tricholoma bresadolanum*, Dřínová hora hill, Karlštejn NNR, Bohemian Karst, Czech Republic, under *Quercus*, 9 Sept. 2010, leg. V. Janda & N. Melichová (CB 17102). Photo V. Janda.



Fig. 4. *Tricholoma bresadolatum*, Mramor hill, Liteň, Bohemian Karst, Czech Republic, under *Quercus* and *Carpinus*, 20 Sept. 2013, leg. V. Janda & L. Opat (PRM 934113). Photo V. Janda.



Fig. 5. *Tricholoma bresadolatum*, Mramor hill, Liteň, Bohemian Karst, Czech Republic, under *Quercus* and *Carpinus*, 20 Sept. 2013, leg. V. Janda & L. Opat (PRM 934113). Photo V. Janda.



Fig. 6. *Tricholoma bresadolanum*, Mramor hill, Liteň, Bohemian Karst, Czech Republic, under *Quercus* and *Carpinus*, 28 Sept. 2013, leg. V. Janda (PRM 934108). Photo V. Janda.



Fig. 7 (left). *Tricholoma bresadolanum*, Mramor hill, Liteň, Bohemian Karst, Czech Republic, under *Quercus* and *Carpinus*, 28 Sept. 2013, leg. V. Janda (PRM 934107). Photo V. Janda.

Fig. 8 (right). *Tricholoma bresadolanum*, Mramor hill, Liteň, Bohemian Karst, Czech Republic, under *Quercus* and *Carpinus*, 21 Sept. 2014, leg. V. Janda & L. Opat (PRM 934118). Photo V. Janda.



Fig. 9. *Tricholoma bresadolatum*, Mramor hill, Liteň, Bohemian Karst, Czech Republic, under *Quercus* and *Carpinus*, 16 Sept. 2014, leg. V. Janda (PRM 934109). Photo V. Janda.



Fig. 10 (left), 11 (right). *Tricholoma bresadolatum*, Mramor hill, Liteň, Bohemian Karst, Czech Republic, under *Quercus* and *Carpinus*, 21 Sept. 2014, leg. V. Janda & L. Opat (PRM 934118). Photo V. Janda.

V. Janda & L. Opat, det. V. Janda (PRM 934113); *ibid.*, 28 Sept. 2013, leg. & det. V. Janda (PRM 934107, PRM 934108); *ibid.*, 30 Aug. 2014, leg. V. Janda, T. Pavelka & L. Opat, det. V. Janda (PRM 934112); *ibid.*, 7 Sept. 2014, leg. L. Opat & T. Pavelka, det. V. Janda (PRM 934114, PRM 934117); *ibid.*, 13 Sept. 2014, leg. V. Janda & T. Pavelka, det. V. Janda (PRM 934115, PRM 934116); *ibid.*, 16 Sept. 2014, leg. & det. V. Janda (PRM 934109, PRM 934110, PRM 934111); *ibid.*, 21 Sept. 2014, leg. V. Janda & L. Opat, det. V. Janda (PRM 934118). – Moravia. Jinačovice (South Moravia, Bobravská vrchovina uplands), Baba forest complex, south-eastern slope of Velká Baba hill, alt. 430 m, under *Quercus* on metabasalt, 22 Sept. 2014, leg. J. Salaš, det. D. Dvořák (herb. D. Dvořák 140922-20). – Nevojice (South Moravia, Litenčická pahorkatina hills), Malhotky National Nature Monument, alt. 290 m, fringe of oak forest, under *Quercus* on sandstone with conglomerate, 14 Oct. 2013, leg. & det. J. Běťák (herb. J. Běťák 13/1538).

DISCUSSION

Taxonomic position and similar species

The infrageneric classification of *Tricholoma* has changed several times in the past. According to Bon (1991), *T. bresadolanium* belongs to subgenus *Tricholoma*, section *Terrea*, subsection *Virgatina*. Riva (2003) adopted his system, but called this section *Atrosquamosa* and the subsection *Virgata*. Based on ITS data, Christensen & Heilmann-Clausen (2013) published a phylogenetic tree containing 16 infrageneric clades (sections with no formal taxonomic status); *T. bresadolanium* belongs to a clade called section *Tricholoma*, including 15 species. Other grey-coloured tricholomas are distributed within sections *Pardiniticis* (2 species), *Atrosquamosa* (5 species), *Terrea* (7 species) and *Saponacea* (4 species). *Tricholoma borgsjoeënsse* Jacobsson & Muskos and *T. josserandii* Bon have isolated positions. This phylogenetic tree confirms that *T. bresadolanium* is most related to *T. sciodes* (Pers.) C. Martín and *T. virgatum* (Fr.: Fr.) P. Kumm.; these all have a bitter or acrid taste. While *T. virgatum* has a markedly different habitat (under *Picea*, rarely *Betula* or *Pinus*, commonly on acid soils), *T. sciodes* is mycorrhizal with *Fagus*. *Tricholoma bresadolanium* differs by its rounded-flattened pileus having at most a low, wide (never acute) umbo and its stipe with more or less distinct girdles of grey to blackish scales (however, this character may not be noticeable in young and pale fruitbodies). Moreover, its fruitbodies stain reddish brown when handled. However, it is necessary to add that collections identified as *T. sciodes* before 1977, when Cléménçon described *T. bresadolanium* (Cléménçon 1977), may include this species.

Concerning other similar taxa of the genus *Tricholoma*, particularly *T. squarulosum* Bres. has distinct dark squamules on a paler background on its stipe. It differs from *T. bresadolanium* above all in the densely felty to recurved scaly, almost black pileus and in its farinaceous taste. Other representatives of sect. *Atrosquamosa* growing under deciduous trees in thermophytic regions, namely

T. basirubens (Bon) A. Riva & Bon and *T. orirubens* Quél., and also two species of sect. *Pardinicutis*, i.e. *T. pardinum* (Pers.) Quél. and *T. filamentosum* (Alessio) Alessio, have a likewise farinaceous or only slightly bitter taste (and mostly also a farinaceous smell after cutting). Besides, both members of sect. *Pardinicutis*, as well as *T. saponaceum* (Fr.) P. Kumm., are well distinguished from *T. bresadolatum* by their presence of clamp connections.

Tricholoma filamentosum sometimes has very similar ecological requirements to those of *T. bresadolatum*, but also e.g. *T. basirubens* and *T. squarulosum* may occur at the same localities. However, all these similar species do not have a taste becoming bitter to acrid. Generally, the most typical characters of *T. bresadolatum* are the slightly concentrically squamulose greyish pileus with or without a low broad umbo, the stipe with girdles of grey squamules, the taste becoming bitter to acrid, and its occurrence mainly under oaks in thermophilic forests.

Ecology and distribution

According to our observations, *Tricholoma bresadolatum* forms fruitbodies from late August to mid-October having its maximum in September. The typical habitats of *T. bresadolatum* are thermophilic deciduous forests with a dominant presence of oaks on alkaline soils: Euro-Siberian steppic woods with *Quercus* spp. and partly also *Galio-Carpinetum* oak-hornbeam forests in terms of the Natura 2000 classification (Chytrý et al. 2010). Localities can be characterised as rather natural forests composed of native trees and of long-term stability. The species is well integrated into the thermophilic fungal communities composed of rare and protected macromycetes. We propose including *T. bresadolatum* into the next edition of the Red list of macromycetes of the Czech Republic and classifying it in the Critically Endangered (CR) category.

Other available data on the distribution of *T. bresadolatum* in Europe are from Austria, Belgium, France, Germany, Hungary, Italy, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, and United Kingdom (Hagara 1989, 2014, Laganà et al. 1999, Noordeloos & Christensen 1999, Courtecuisse & Duhem 2000, Galli 2003, Ludwig 2012, Christensen & Heilmann-Clausen 2013, Menéndez Valderrey on-line). Its occurrence is reported predominantly under *Quercus*, but sometimes also under *Fagus* (e.g. Bon 1988, Hagara 1989, Ludwig 2012) and possibly *Castanea* (Christensen & Heilmann-Clausen 2013). The species is relatively common in the Apennines (Galli 2003), but uncommon to very rare in most of the countries (especially outside the Mediterranean zone).

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