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КРАТКИЕ СООБЩЕНИЯ

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MICROMYCETES ROSSICAE: CHOROLOGICAL AND TAXONOMICAL NOTES. 6. *DIATRYPELLA QUERCINA* (*XYLARIALES*, *ASCOMYCOTA*) IN RUSSIA

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The present notice continues the series on rare and interesting species of microfungi and is devoted to the stromatic ascomycete *Diatrypella quercina* (*Xylariales*, *Ascomycota*), the saprotroph associated with crown self-thinning in *Quercus robur*. An extended morphological description of the species is given, and its differences from closely related species, *Diatrypella favacea* and *D. pulvinata*, are analyzed. The data on the global and regional distribution of this rather scarce species are analyzed. The list of studied exsicates and herbarium documentation is provided. The conclusion concerning the optimum range of *D. quercina* is given.

Keywords: ascospore variability, *Diatrypaceae*, *Quercus robur*, stromatic ascomycetes

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The present report continues a series devoted to rare and interesting species of microfungi from various regions of Russia that cause rust, shoot deformations/decay or leaf spots (Zmitrovich et al., 2020a, 2020b; Dudka, Zmitrovich, 2020, 2021; Zmitrovich, 2023), and it focuses on the stromatic ascomycete *Diatrypella quercina*, a member of the *Diatrypaceae* family (*Xylariales*, *Sordariomycetes*). This saprotrophic fungus infests small twigs of *Quercus* (rarely *Castanea*) representatives, where it forms dark-colored stromata with deeply immersed perithecia and a long neck. Traverso (in Saccardo, Traverso, 1904) described *Cytosporina quercina* (modern name *Libertella quercina*) from branches of *Quercus* and *Castanea* in Italy, France, and Germany, and this taxon was later identified as *Diatrypella quercina* anamorph (Grove, 1937).

In the European part of Russia, the anamorph of this species has not been reported, whereas the teleomorph is found quite often on small dry branches of *Quercus robur*, although it has rarely been reported in the literature. The purpose of this report was to encompass research on this interesting pyrenomycete and provide its detailed morphological diagnosis, assessing the variability of macro- and microstructures.

Macroscopic photographs were taken using a Nikon D80 camera with an AF Micro Nikkor 60 mm lens. Micromorphological analysis of stromata was performed using a Zeiss AxioImager-A1 light microscope. Micropreparations were mounted in distilled water or a 5% KOH solution. The sizes of asci and ascospores were measured in 30 random replicates in water. The variability of ascospores was assessed according to the methods proposed by Parmasto et al. (1987).

Diatrypella quercina (Pers.) Cooke, J. Bot. Lond. 4: 99, 1866. ≡ *Sphaeria quercina* Pers., Neues Mag. Bot. 1: 82, 1794. ≡ *Nemania quercina* (Pers.) Gray, Nat. Arr. Brit. Pl. 1: 517, 1821. ≡ *Stromatosphaeria quercina* (Pers.) Grev., Fl. Edin.: 358, 1824. ≡ *Diatrype quercina* (Pers.) Fr., Summa Veg. Scand.: 385, 1849. ≡ *Capnodium quercinum* (Pers.) Berk. et Desm. in Berk., J. Royal Hortic. Soc. 4: 252, 1849. ≡ *Coniotheciella quercina* (Pers.) Speg., Phys. Rev. Soc. Arg. Cienc. Nat. 4 (17): 295, 1918. = *Cytosporina quercina* Traverso, Boll. Soc. Bot. Ital., 1904: 213, 1904 (nomen anamorphosis). = *Libertella quercina* Grove, British Stem- and Leaf-Fungi (nomen anamorphosis) 2: 306, 364, 1937. – Fig. 1.

Exsicates: G. Linhart, Fungi hungarici, № 31 (178), 1883; G.L. Rabenhorst, Fungi europaei, № 635, 1887; F. Petrak, Flora Boemiae et Moraviae exsiccata, ser. 2, № 78, 1911; Ex Herbario Academiae Scientiarum Ucrainicae, 1923; J. Kochman, Mycotheca Polonica, Fasc. 14, № 338, 1962; L. Holm et S. Ryman, Fungi Exsiccati suecici, praesertim upsaliensis, № 551, 1992.

Stromata arranged in large numbers without a definite order, sometimes crowded and merging, sometimes quite far apart, black or dark brown, initially truncated-conical, more or less rounded or indistinctly three- or four-sided in outline, then cushion-shaped, convex or cut-flattened, initially surrounded by lobes of broken host periderm, then free, tan-colored inside, 1.5–4 mm diam., 0.8–1.5 mm high above the level of the cortex; the surface is rather rough due to slightly protruding stomata. The black line, continuing downwards and somewhat narrowed in the bark, extends inside the substrate and runs along the wood, merging with the "wall" of adjacent stromata.

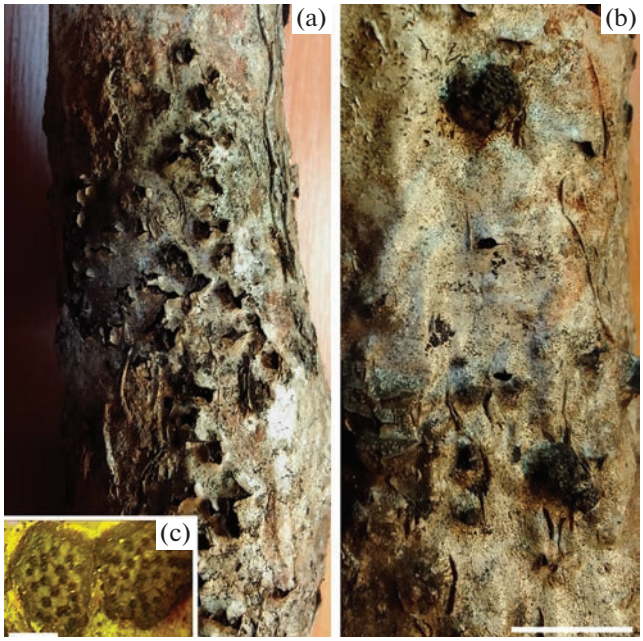

Fig. 1. *Diatrypella quercina* (LE 287712): ectostromata in periderm-covered areas of infested oak branch (a); individual ectostromata (b); ectostromata under 6× magnification. Scales: 5 mm (a, b); 1 mm (c).

Perithecia 6–24 per stroma, (350) 450–750 μm diam., globose-subovate, sometimes angular, with rather strongly protruding striated stomata. Perithetium neck 250–550 μm long and 100–180 μm thick, distinctly protruding, sometimes very distinctly three- or four-furrowed, sometimes almost smooth, black and shining. Peridium up to 30 μm thick, brown, of *textura oblita*, neck densely lined with periphyses. Interascal tissue consists of sparse thin-walled tapering paraphyses, often disappearing at maturity. Asci (60) 80–120 (spore-contained part) × (9) 10–14 (15) μm, club-shaped to narrowly fusiform, distinctly stalked (stalk 20–30 μm on average), apex rounded, thick-walled, with distinct small apical ring. Ascospores (7.0) 9.5–11.5 (12.0) × × 1.9–3.0 μm, allantoid, with strongly refractive ends, light brown, smooth, thin-walled.

Saprotroph on dead branches of oak (*Quercus*) and chestnut (*Castanea*). Causes a white rot.

Anamorph: *Libertella quercina* Grove, British Stem- and Leaf-Fungi (Coelomycetes) 2: 306, 364, 1937. Conidiomata form as locules within a young stroma. Conidiogenous cells are sympodial, formed as branches of conidiophores, elongated and tapering. Conidia filiform, sickle-shaped, colorless.

Distribution: Europe (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, the Netherlands, Norway, Poland, Russia, Slovakia, Sweden, Switzerland, United Kingdom, Ukraine); Asia (Japan); North America (USA); South America (Suriname); Australia (GBIF, 2023).

Russian material studied: Saratov City vic., on dry branches of *Quercus robur*, 13.05.1928, leg. et det. B. Karakulin (LE 121789). – Saratov Region, Saratovsky District, on fallen branches of *Q. robur*, sine data, det. E.S. Popov (LE 323566). – Mariy El Republic, on fallen branches of *Q. robur*, 03.07.1932, coll. et det. B.P. Vassilkov (LE 121783). – Tambov Region, Saburovo, on fallen branches of *Q. robur*, 15.09.1928, leg. et det. N. Potebnya (LE 171323). – Tula oblast, Shchekino district, Plavskoe forestry, Kryukovskoe forestry (Selivanovskaya dacha), maple-linden oak forest, on fallen branches of *Q. robur*, 05.07.2015, leg. G.I. Zarudnaya, A.B. Shishlyannikova, det. I.V. Zmitrovich (LE 287710). – *ibid.*, Selivanovo, Park Dendrarium "Krapivena Forestry Technical School", on fallen branches of *Q. robur*, 08.07.2015, leg. A.B. Shishlyannikova, det. I.V. Zmitrovich (LE 287711). – Pskov Region, Loknyansky district, Bashovo vic., Verkhnyaya Doroga tract, on fallen branches of *Q. robur*, 12.08.1997, leg. et det. E.S. Popov (LE 222318). – *ibid.*, Bezhanitsky district, Chikhichevskoye, near the village of Polozovo, on fallen branches of *Q. robur*, 06.08.2019, leg. A.B. Shishlyannikova, det. I.V. Zmitrovich (LE 287712). – Leningrad Region, Kingisepp district, complex nature reserve "Oak forests near the Velkota village", on fallen branches of *Q. robur*, 23.08.2015, leg. G.I. Zarudnaya, A.B. Shishlyannikova, det. I.V. Zmitrovich (LE 287713). – St. Petersburg, Botanical Garden, on dry branches of *Q. robur* (ut *Q. pedunculata*), 08.1920, sine nom. leg. (LE 121788). – *ibid.*, 01.05.1920, leg. et det. A.S. Bondartsev (LE 121772, LE 121777). – St. Petersburg, Pushkin, Babolovsky Park, on fallen branches of *Q. robur*, 16.07.2017, leg. A.B. Shishlyannikova, det. I.V. Zmitrovich (LE 287714).

The species in question is found on small branches of oak and chestnut in Eastern Europe, mainly on *Quercus robur*, where it causes white soft rot (the laccase activity of representatives of the genus *Diatrypella* and its alies has been noted in the literature – Hyde et al., 2020). Wood in the advanced stages of decay becomes light, dry and white, and easily rumps when pressed. Inside the stroma, between the perithecia, amorphous products of lignin decomposition accumulate within the black line; its stromata breaks through and exfoliates the periderm. Older branches sometimes lose their entire periderm and ectostromata. In the last case, the fungus can be detected from the entostromata remnants.

The average sizes of ectostromata, established on the basis of the material available to us, are grouped around 2 mm (Table 1). Stromata are often crowded due to the fact that they are connected inside the wood by a common sclerotial plate, but the young initials of such colonies break through with separate stromata. The normal number of perithecia in one stroma is 6–12, but some confluent stromata can unite more than 20 pe-rithecia (Fig. 1, c).

Being rather variable, the species can be confused with *Diatrypella pulvinata* Nitschke, which usually forms larger stromata and can also can grow on small branches of *Quercus robur*, but differs from this species in more pronounced cone-shaped and angular stromata. Microscopically, *Diatrypella quercina* is well distinguished by the lunate-allantoid ascospores, whereas the spores of *D. pulvinata* are weakly curved. Another species often seen on oak branches is *D. favacea* (Fr.) Ces. et De Not., whose stromata are also larger on average. Microscopically, this species differs from *D. quercina* in having cylindrical (vs pedunculate) asci and shorter ascospores not exceeding 10 μm in length.

Table 1. Morphological characterization of three oak-inhabiting *Diatrypella* species

Виды/признаки	*D. quercina*	*D. favacea*	*D. pulvinata*
Ectostromata diameter, mm	1.5–4 ± 0.5	3–10 ± 2.5	2–7 ± 1.5
Perithecia number per stroma	(3) 6–16 (24)	(6) 8–56 (60)	(6) 8–30 (36)
Ascus shape	clavate-pedunculate	subcylindrical	clavate-pedunculate
Ascus sizes, μm	(60)80–120 × (9) 10–14 (15) ± 1–3	60–190 × 9–12 ± 1–5	60–80 × 8–12 ± 1–3
Ascospore shape	allantoid	slightly curved	slightly curved
Ascospore sizes (l × w), μm	(7.0) 9.5–11.5 (12.0) × 1.9–3.0	6.5–8.7 (9.0) × 1.4–1.8	(6) 6.5–7 (7.5) × 1.3–1.7
Spore quotient (Qm)	4.8	4.8	4.5

Note. *All measurements were made in 30 random replicates.

Jackrogersella cohaerens (Pers.) L. Wendt, Kuhnert et M. Stadler growing on this substrate may also have a superficial resemblance to cushion-shaped forms of *Diatrypella quercina*, but the stromata of this fungus are not immersed and it is characterized by completely different microscopy (low-spored asci with large pigmented ascospores).

For a particularly long time, this species was considered in the genus *Diatrypella*, although already Ruhland (1900) and Wehmeyer (1926) proposed to consider it, following by Fries (Fries, 1849), in the genus *Diatrype*, which was recently supported by molecular data (Carpouron et al., 2021).

In Russia, the records of this species are known only from its European part (Popov et al., 2007, 2008, 2013; Hüseyin et al., 2016; Mitrofanova, 2018; Sidelnikova et al., 2018) (Table 2). The find of *D. quercina* in the Russian Far East (Koval, 1972) was later reidentified as *D. pulvinata* (Vasilyeva, 1998). In Ukraine, this species was reported for all regions (Smitskaya et al., 1986), which correlates well with the confinement of *D. quercina* to the optimum range of *Quercus robur*. We associate the finds in Japan, Suriname and Australia (GBIF, 2023) with the introduction of alien trees and shrubs that carried the propagules of alien fungal species.

Table 2. Data on distribution of *Diatrypella quercina* in Russia

Источник	Регион
Leningrad Region	LE 287713, Popov et al. (2007)
Mariy El Republic	LE 121783
Pskov Region	LE 222318, LE 287712, Popov et al. (2008, 2013)
Saint Petersburg	LE 121772, LE 121777, LE 121788, 287714, Sidelnikova et al. (2018)
Saratov City	LE 121789
Saratov Region	LE 323566
Tambov Region	LE 171323
Tula Region	LE 287710
Ulyanovsk Region	Huseyin et al. (2016); Mitrofanova (2018)

Summarizing the available material on *Diatrypella quercina*, it should be noted that this is basically a species of European – North American distribution with an optimum range in the nemoral zone. Following the *Quercus robur*, this pyrenomycete irradiates in the southern taiga regions of Eastern Europe. At the same time, some collections from taiga regions should be revised for differentiation with similar *Diatrypella favacea* and *D. pulvinata*.

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Микромицеты России: географические и таксономические заметки. 6. *Diatrypella quercina* (*Xylariales*, *Ascomycota*) в России

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Сообщение продолжает серию по редким и интересным видам микромицетов и посвящено стромати-ческому аскомицету *Diatrypella quercina* (*Xylariales*, *Ascomycota*) – сапротрофу, ассоциированному с из-реживанием крон *Quercus robur*. Приведено расширенное морфологическое описание данного вида, проанализированы его сходства и различия с близкими видами *Diatrypella favacea* и *D. pulvinata*. Про-анализированы данные о глобальном и региональном распространении этого не очень широко распро-страненного таксона, приведен список изученных эксикатов и гербарная документация. Сделано предположение об оптимум-ареале *D. quercina*, соответствующем неморальной зоне.

Ключевые слова: изменчивость аскоспор, строматические аскомицеты, *Diatrypaceae*, *Quercus robur*