

The lichenicolous genus *Biatoropsis* (Tremellales, Basidiomycota) in Belarus

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Abstract: Seventeen specimens of lichenicolous fungi of the genus *Biatoropsis* were found during the revision of 538 herbarium collections of the lichen genus *Usnea* in Belarus. Two *Biatoropsis* species were identified, *Biatoropsis rubicundae* (on *Usnea ceratina*) and *B. usnearum* (on *U. florida*, *U. intermedia* and *U. subfloridana*). *Biatoropsis rubicundae* is reported here as new to Belarus. Based on the studied material, morphological descriptions, ecological preferences and distribution data for the identified species are provided.

Keywords: biodiversity, lichens, distribution, substrate, ecology, *Usnea*

INTRODUCTION

The genus *Biatoropsis* Räsänen comprises lichenicolous fungi of the Tremellomycetes that grow on thalli of the lichen genera *Usnea* Dill. ex Adans. and *Protousnea* (Motyka) Krog. Initially, this genus was described as an unusual ascomycete resembling lichens of the genus *Biatora*, but later it was recognized as a representative of the Basidiomycota (Diederich & Christiansen, 1994; Millanes et al., 2014, 2016).

In Belarus, a single species, *Biatoropsis usnearum*, was previously reported by Golubkov & Kobzar (2007) and Golubkov (2011). However, recent studies have shown that this taxon, previously considered as common and cosmopolitan, represents a complex of morphologically poorly distinguishable species (Diederich et al., 2022). Furthermore, as many herbarium specimens previously attributed to *Biatoropsis usnearum* may belong to other taxa, the global distribution and host selection of *B. usnearum* s. str. remain unclear. Therefore, the revision of available specimens of the genus *Biatoropsis* in Belarus seems to be an important task to assess its diversity, distribution and ecology within the country.

MATERIAL AND METHODS

For this study, 538 lichen specimens of the genus *Usnea* collected in 1924–2018 and stored in herbaria of Francisk Skorina Gomel State University (GSU), V.F. Kuprevich Institute of

Experimental Botany of the National Academy of Sciences of Belarus (MSK-L), Central Botanical Garden of the National Academy of Sciences of Belarus (MSKH), Belarusian State University (MSKU) and Komarov Botanical Institute of the Russian Academy of Sciences (LE) were studied.

The morphology and anatomy were studied using a Nikon SMZ-745 stereomicroscope and a Nikon Eclipse 80i light microscope. Microscopic characters were studied using hand-cut sections stained with Phloxin (1% in water) after pretreatment with KOH (5%), following the methods of Diederich (1996). Basidia and other structures were measured in aqueous preparations. Measurements of basidia and basidiospores are presented according to the following format: (minimum) (average – standard deviation) (average + standard deviation) (maximum) and are accompanied by an indication of the number of measurements (n).

The composition of secondary metabolites of host lichens was studied using thin-layer chromatography (TLC) in solvent C system (Orange et al., 2001).

Morphological descriptions are based on Belarusian material.

RESULTS AND DISCUSSION

During the revision of 538 herbarium collections of *Usnea* collected in Belarus, 17 specimens infected with *Biatoropsis* were found. Two species were identified, *B. rubicundae* Diederich &

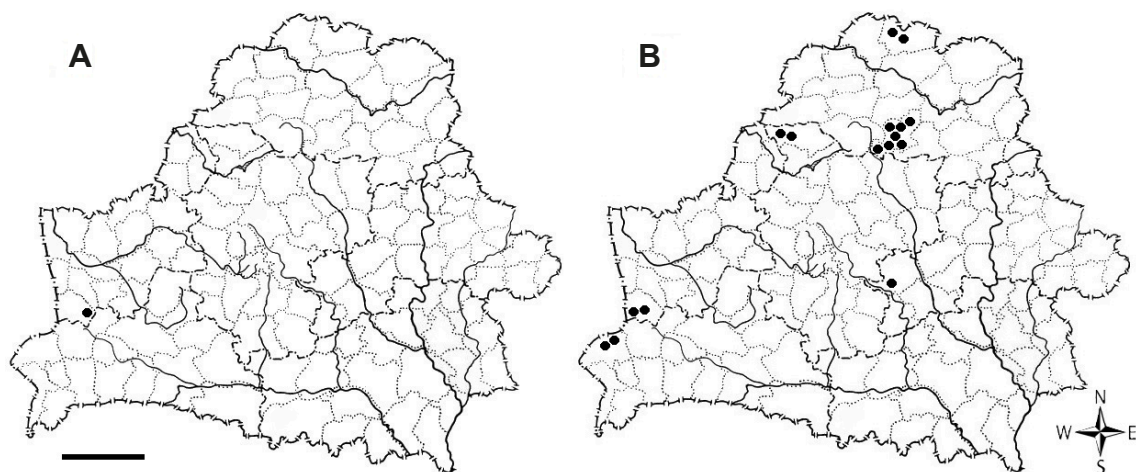


Fig. 1. Distribution of *Biatoropsis rubicundae* (A) and *B. usnearum* (B) in Belarus (scale = 100 km).

Millanes (1 specimen), new to Belarus, and *B. usnearum* Räsänen s. str. (16 specimens).

BIATOROPSIS RUBICUNDAE Diederich & Millanes

Basidiomata convex, subspherical or flattened, soon with a narrowed base, up to 0.5 mm in diameter. Surface smooth, sometimes cartilaginous, light to dark brown. Basidia clavate to cylindrical, with 1–3 transverse septa, $25.5\text{--}31.5 \times 4.0\text{--}5.0 \mu\text{m}$ ($n=5$), the lower cell attenuated. Basidiospores and conidia not observed in the Belarusian material.

The much more common *Biatoropsis usnearum* differs by usually darker and larger basidiomes up to 1.5 mm in diameter as well as the host selection.

Ecology. *Biatoropsis rubicundae* is confined to thalli of *Usnea ceratina* Ach., *U. erinacea* Vain. and *U. rubicunda* Stirt. (Diederich et al., 2022). The single Belarusian specimen was found on the thallus of *Usnea ceratina*. The host lichen was collected on the bark of *Alnus glutinosa*, under wet conditions.

Distribution. *Biatoropsis rubicundae* has a wide geographical range and is known from Europe, North America, Africa and Oceania (Diederich et al., 2022). Here we report the species as new to Belarus, where it was found on the territory of the Belovezhskaja Puscha National Park (Figure 1A).

Material examined. Belarus, Grodno region, Svisloch district, Belovezhskaja Puscha National Park, Oschepskoje forest, 120 quarter, 1 km north of the Rudnya village, $52^{\circ}51'N$, $24^{\circ}35'E$, on *Usnea ceratina* growing on *Alnus glutinosa*, 28.09.1984, V. V. Golubkov (GSU-2199).

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Basidiomata variable in shape, size and colour, mainly subspherical and convex with a constricted base, often with lobate margins, sometimes with a concave central part, surface smooth, rarely tuberculate, light or dark brown to black, $(0.5\text{--})0.6\text{--}1.0\text{--}(1.5)$ mm in diameter ($n=40$). Basidia clavate to cylindrical, with 1–3 transverse septa, $(19.5\text{--})20.7\text{--}27.1\text{--}(30.0) \times (3.5\text{--})3.8\text{--}4.6\text{--}(5.0) \mu\text{m}$ ($n=34$). Basidiospores spherical to ellipsoidal with a distinct apiculus, $(5.5\text{--})6.0\text{--}7.2\text{--}(8.0) \times (5.5\text{--})5.8\text{--}6.8\text{--}(7.5) \mu\text{m}$ ($n=15$). Conidia catenulate, cells $(3.0\text{--})3.2\text{--}4.0\text{--}(4.5) \times (2.5\text{--})2.7\text{--}3.3\text{--}(3.5) \mu\text{m}$ ($n=20$).

Ecology. *Biatoropsis usnearum* s. str. is confined to various *Usnea* species, namely *U. barbata* (L.) F. H. Wigg., *U. cavernosa* Tuck., *U. florida* (L.) F. H. Wigg., *U. glabrescens* (Vain.) Räsänen, *U. intermedia* (A. Massal.) Jatta, *U. subfloridana* Stirt. (Diederich et al., 2022). In Belarus, it was found on *Usnea florida* (2 specimens), *U. intermedia* (1) and *U. subfloridana* (13 specimens).

In Belarus, the species was collected in various plant communities, viz. coniferous, broadleaved and mixed forests. The hosts grew on *Betula*

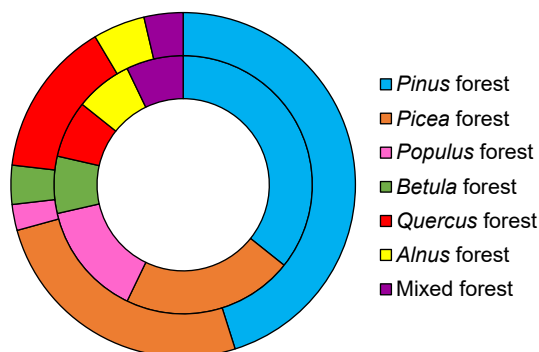


Fig. 2. Ecological selectivity of *Usnea* species (outer circle) and *Biatoropsis usnearum* (inner circle) in Belarus

pendula (6 specimens), *Picea abies* (3), *Alnus glutinosa* (3), *Quercus robur* (2) and *Pinus sylvestris* (2). No large differences were observed in the ecological preferences and substrate selectivity of host lichens and *B. usnearum*, with the exception for an increase in the proportion of infected specimens found in black alder forests on *Alnus glutinosa* (Figures 2, 3). According to Łubek et al. (2019), the species diversity and frequency of lichenicolous fungi may depend on the type of forest, the species of its constituent trees, and the substrate of host lichens due to their demands for high air humidity. In Belarus, *Alnus glutinosa* occurs mainly in humid and swampy communities, therefore our data are mainly congruent with the findings of Łubek et al. (2019).

Distribution. The occurrence of *Biatoropsis usnearum* s. str. was confirmed for Europe and North America by Diederich et al. (2022). In Belarus, *Biatoropsis usnearum* is quite a rare species and is known from 16 localities, mainly in protected areas: Berezinsky Biosphere Reserve, Belovezhskaja Puscha National Park and Narochansky National Park (Figure 1B).

Materials examined. Belarus, Brest region, Kamenets district, Belovezhskaja Puscha National Park, Korolevo-Mostovskoje forest, 777 quarter, 52°35'N, 23°51'E, on *Usnea subfloridana* growing on the bark of *Quercus robur*, 18.07.1983, V. V. Golubkov (GSU-2200); same forest, 807 quarter, vicinity of Kamenyuki village, 52°33'N, 23°47'E, in *Quercus* forest on *U. subfloridana* growing on *Q. robur*, 11.07.1983, V. V. Golubkov (GSU-2201); Grodno region,

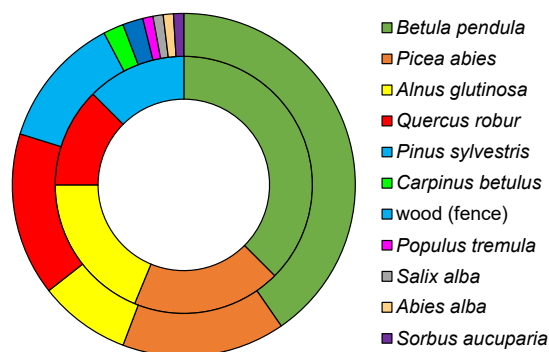


Fig. 3. Substrate selectivity of *Usnea* species (outer circle) and *Biatoropsis usnearum* (inner circle) in Belarus

Svisloch district, Belovezhskaja Puscha National Park, Svisloch forest, 120 quarter, 52°50'N, 24°02'E, in *Alnus* forest, on *U. subfloridana* growing on *Alnus glutinosa*, 28.09.1984, V. V. Golubkov (GSU-2211); Belovezhskaja Puscha National Park, Yazvinskoje forest, 71B quarter, close to Tikhovolya village, 52°50'N, 24°00'E, in *Picea-Pinus* forest on *U. subfloridana* growing on *Betula pendula*, 26.09.1984, V. V. Golubkov (GSU-2212); Minsk region, Miadzel district, Narochansky National Park, close to Riduplja village, 54°53'N, 26°34'E, in *Picea* forest on *U. intermedia* growing on *Picea abies*, 29.06.2005, A. P. Yatsyna, (MSKU, GSU-2213); close to Stepenyovo village, 54°53'N, 26°40'E, in *Pinus* forest on *U. subfloridana* growing on *Pinus sylvestris*, 11.07.1978, V. V. Golubkov (GSU-2215); Mogilev region, Osipovichy district, Tselsk forest, 23 quarter, close to Tsel village, 53°22'N, 28°27'E, on *U. florida* growing on *B. pendula*, 31.05.1968, N. V. Gorbach (GSU-2216); Vitebsk region, Lepel district, Berezinsky Biosphere Reserve, Palik forest, 650 quarter, 11 subquarter, 54°35'N, 28°23'E, in *Quercus-Populus* forest on *U. subfloridana* growing on *P. abies*, 23.06.2008, P. N. Bely (GSU-2202); same place, on *U. subfloridana* growing on *A. glutinosa*, 06.08.2008, P. N. Bely (GSU-2203); Berezinsky Biosphere Reserve, on a road from Kraitsy village to Brody village, 54°39'N, 28°15'E, in mixed forest on *U. subfloridana* growing on *B. pendula*, 20.10.1962, N. V. Gorbach (GSU-2204); Berezinsky Biosphere Reserve, Kutuy tract, 54°56'N, 28°15'E, in *Pinus* forest on *U. subfloridana* growing on *B. pendula*, 16.06.1968, N. V. Gorbach (GSU-2205); Berezinsky Biosphere

Reserve, Uvasok tract, 54°43'N, 28°15'E, in a native *Betula* forest on *U. florida* growing on *B. pendula*, 06.1963, N. V. Gorbach (GSU-2206); experimental forest hunting farm “Barsuki”, 56 quarter, 31 subquarter, 54°52'N, 28°09'E, in *Pinus* forest on *U. subfloridana* growing on *P. sylvestris*, 14.07.2009, P. N. Bely (GSU-2207); the same hunting farm, 79 quarter, 18 subquarter, 54°50'N, 28°05'E, in *Picea* forest on *U. subfloridana* growing on *P. sylvestris*, 13.07.2009, P. N. Bely (GSU-2208); Rossony district, close to Yukhovichi village, 56°00'N, 28°39'E, in *Picea* forest on *U. subfloridana* growing on *A. glutinosa*, 29.08.1987, V. V. Golubkov (GSU-2209); Fomino Nature Reserve, 55°56'N, 28°49'E, in *Picea-Betula-Pinus* forest on *U. subfloridana* growing on *B. pendula*, 03.10.1984, V. V. Golubkov (GSU-2210).

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REFERENCES

- Golubkov, V. V. 2011. An annotated list of lichenicolous fungi of Belarus. *Botany: Research* 40: 295–306 (in Russian).
- Golubkov, V. V., Kobzar, N. N. 2007. The first annotated list of lichen-forming and lichenicolous fungi of the Berezinsky Biosphere Reserve. Specially Protected Natural Territories of Belarus. *Botany: Research* 2: 11–34 (in Russian).
- Diederich, P. 1996. The lichenicolous heterobasidiomycetes. *Bibliotheca Lichenologica* 61: 1–198.
- Diederich, P. & Christiansen, M. S. 1994. *Biatoropsis usnearum* Räsänen, and other heterobasidiomycetes on *Usnea*. *Lichenologist* 26: 47–66. <https://doi.org/10.1006/lich.1994.1004>
- Diederich, P., Millanes, A. M., Wedin, M., Lawrey, J. D. 2022. *Flora of Lichenicolous Fungi. Vol. 1. Basidiomycota*. Luxembourg: National Museum of Natural History: 354 pp.
- Lubek, A., Kukwa, M., Czortek, P., Jaroszewicz, B. 2019. Lichenicolous fungi are more specialized than their lichen hosts in primeval forest ecosystems, Białowieża Forest, northeast Poland. *Fungal Ecology* 42: 1–10. <https://doi.org/10.1016/j.funeco.2019.100866>
- Millanes, A. M., Truong, C., Westberg, M., Diederich, P., Wedin, M. 2014. Host switching promotes diversity in host-specialized mycoparasitic fungi: uncoupled evolution in the *Biatoropsis-Usnea* system. *Evolution* 68: 1576–1593. <https://doi.org/10.1111/evo.12374>
- Millanes, A. M., Diederich, P., Westberg, M., Wedin, M. 2016. Three new species in the *Biatoropsis usnearum* complex. *Herzogia* 29: 337–354. <https://doi.org/10.13158/heia.29.2.2016.337>
- Orange, A., James, P. W., White, F. J. 2010. *Microchemical methods for the identification of lichens*. London: 101 pp.