

First report of *Cladosporium herbarum* (Capnodiales, Dothideomycetes) on the rare moss *Buxbaumia viridis* in Bulgaria

Melania M. Gyosheva & Rayna K. Natcheva

Department of Plant and Fungal Diversity and Resources, Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 23 Acad. G. Bonchev Str., 1113 Sofia, Bulgaria, e-mail: melanygyosheva@abv.bg (corresponding author)

Received: May 10, 2022 ▷ Accepted: July 21, 2022

Abstract. This paper reports the first finding of *Cladosporium herbarum* (Cladosporiaceae, Dothideomycetes) on the moss *Buxbaumia viridis* in Bulgaria. A description and illustrations of the micromorphological features of the examined specimen are provided.

Key words: Ascomycota, Bulgaria, Buxbaumiaceae, Central Rhodopi Mts., Cladosporiaceae, moss sporophytes

Citation: Gyosheva, M.M. & Natcheva, R.K. 2022. First report of *Cladosporium herbarum* (Capnodiales, Dothideomycetes) on the rare moss *Buxbaumia viridis* in Bulgaria. -- Phytologia Balcanica, 28 (2): 157-160. -- ISSN 1310-7771 (print), 1314-0027 (online).

Introduction

Cladosporium herbarum (Pers. : Fr.) Link (Cladosporiaceae, Dothideomycetes) is the type species of the genus *Cladosporium* Link. It is a member of *Cladosporium herbarum* complex, which includes a group of species with *Davidiella* sexual morphs (Schubert & al. 2007; Bensch & al. 2012; Gonzáles & al. 2021, etc.). *Cladosporium herbarum* is the asexual counterpart of *Davidiella tassiana* (De Not.) Crous & U. Braun.

Cladosporium herbarum is considered as one of the most common and widespread cosmopolitan microscopic fungi. It is generally saprobic and occurs on different organic substrates, especially on dead leaves of herbaceous and woody plants, but also on the sur-

face of living leaves as an epiphyte and as secondary invader on necrotic leaf spots (Kirk & al. 2008; Schubert & al. 2007; Bensch & al. 2012). It is known that *C. herbarum* and *C. epibryum* Cooke & Masee (known in North America), infect the sporophytes of various mosses (Györfy 1911; Prior 1966; Hancock & Brassard 1974). The first record of *C. herbarum* s.l. as parasite on mosses was made by Györfy (1911). The host was *Buxbaumia viridis* (Moug. ex Lam. et DC.) Brid. ex Mag. et Nestl. The fungal mycelium was observed inside and on the surface of the moss capsules. The author also collected *C. herbarum* on mosses from the genera: *Bryum* Hedw., *Gyroweisia* Schimp., *Tortula* Hedw., and *Dicranella* (Müll. Hal.) Schimp. (Boros 1926).

In Bulgaria *C. herbarum* s. str. is reported on various herbaceous plants, mainly cereals (*Avena fatua* L., *Hordeum vulgare* L., *Triticum* spp.) by Hristoff (1934), Nedyalkova & al. (2014, 2019), etc.

The aim of the present paper is to report the first collection of *C. herbarum* on the sporophytes of *B. viridis* in Bulgaria. It is the first finding of this fungus on bryophytes in the country.

The studied specimen of *B. viridis* has been found by the second author during a field investigation in July 2021 in the Central Rhodopi Mts.

Material and methods

Buxbaumia viridis is an epixylic moss occurring in shaded, humid, mainly coniferous forests in the mountain areas (Figs 1, 2a). It grows on dead wood in advanced decay stages. In Bulgaria it is found exclusively on coniferous wood, mostly of *Picea abies* P. Karst. and *Abies alba* Mill., seldom of *Pinus sylvestris* L., *P. nigra* Arnold, *P. peuce* Grieseb., and *P. mugo* Turra. In Europe it has been reported also on

the dead wood of *Fagus sylvatica* L. (Wolf 2015; Deme & al. 2020; Brewczyński 2021; Guillet & al. 2021). The species is of European and national conservation importance. It is included in Annex II of the Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (The Habitats Directive), in Appendix I of the Convention on the conservation of European wildlife and natural habitats (Bern Convention), Annex II of the Biodiversity Act of Bulgaria, and in the Red List of Bulgarian bryophytes as Near Threatened (Natcheva & al. 2006).

The collection locality is a 110 years old spruce forest with canopy closure seven, eastern exposure, and slope ca. 45 degrees.

The microscopic observations of the micromorphological characters (fungal hyphae, conidiophores, conidia) were made under Nikon Eclispe 50i LM after rehydration of moss capsules in water. Twenty five conidia were measured. Microphotographs were taken with Nikon digital camera.

Identification was confirmed using the works of Schubert & al. (2007) and Bensch & al. (2012). The work of Györfy (1911) was used only for primary consult.



Fig. 1. The habitat of *Buxbaumia viridis* in the Central Rhodopi Mts.



Fig. 2. *Buxbaumia viridis*: **a** – *Buxbaumia viridis* in the locality; **b** – *Buxbaumia viridis* infected with *Cladosporium herbarum* (same stage of capsule maturity as in **a**)

The studied specimen is deposited in the Mycological Collection of the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia (SOMF).

Results

Sporophytes from the examined collection of *B. viridis* were deformed, dark brown, shrivelled, mummified. **Fungal mycelium** formed on the capsules a superficial dense network, consisting of brown hyphae. **Hyphae** smooth, septate, loosely branched,

light brown, brown, up to 8 μm thick (Figs 3-4). **Conidiophores** solitary, smooth, walls thickened generally 1-1.5 μm wide, only rarely up to 1.8- 2 μm , septate, brown, (3.5) 5-6.5 (8.5) μm wide, n=18 (Fig. 4). **Cnidia** solitary, 6-10 (12) \times 4-6 (7) μm , ovoid-ellipsoid, ellipsoid, aseptate, pale olivaceous, pale brown, verruculose.

Specimen examined. Central Rhodopi Mts, NW of Smolyan town, two immature sporophytes of *Buxbaumia viridis* on decaying wood of *Picea abies*, in spruce forest, 1925 m a.s.l., 24.626398°E, 41.612569°N, 29.07.2021, leg. R. Natcheva, det. M. Gyosheva (SOMF 30032), Fig. 2b.

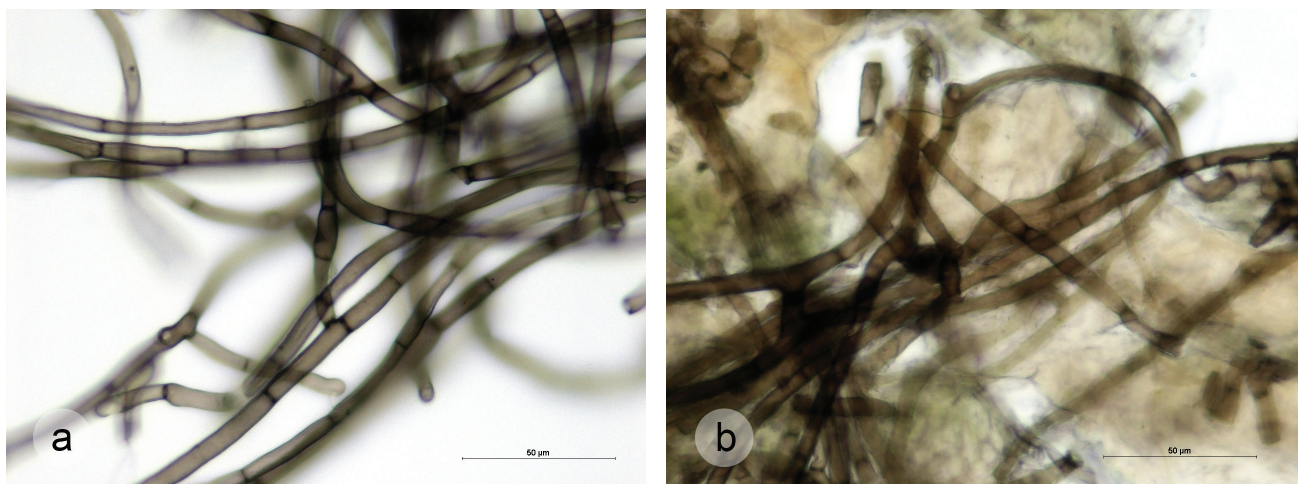


Fig. 3. *Cladosporium herbarum*: **a** – hyphae on the surface of the capsule, **b** – hyphae in the epidermal layer of the capsule

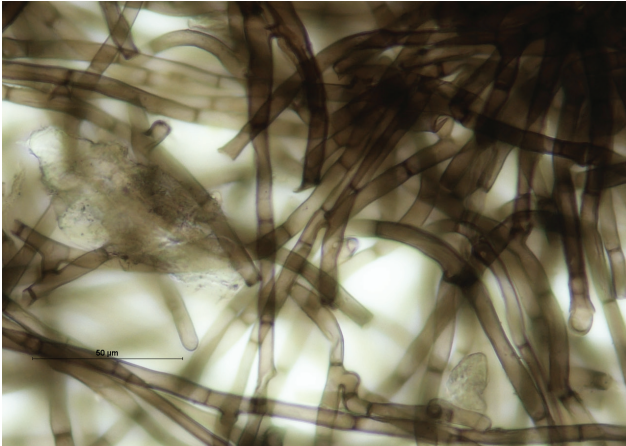


Fig. 4. *Cladosporium herbarum* – hyphae and conidiophores

Discussion

Data about the micromorphological characters of *C. herbarum*, collected in Bulgaria correspond to the data given by Bensch & al. (2012), although there are minor differences in the minimum and maximum values of the measured conidia, which are slightly bigger in the examined collection. The conidiophores and conidia in the Bulgarian specimen are probably in an earlier stage of development. During microscopic observations, the authors found only solitary young conidiophores and aseptate small conidia.

The present collection confirmed the occurrence of *C. herbarum* on the sporophytes of *B. viridis*. This finding enriches the knowledge on the species diversity of bryophilous fungi in Bulgaria. Although *C. herbarum* was found as parasite on a conservation-important species, it seems to invade it seldom and does not pose a threat to the populations of *B. viridis*. Of some 120 sporophytes observed in the study region in 2021, only two were found to be infected.

Acknowledgements. This work was held within the framework of the project „Forest management scenario for improved plant and fungal diversity conservation under climate change” (MFORDIV), № KP-06-№ 31/12, supported by the Bulgarian National Science Fund (BNSF).

References

- Bensch, K., Braun, U., Groenewald, J.Z. & Crous, P.W. 2012. The genus *Cladosporium*. – *Stud. Mycol.*, **72**: 1-404.
- Boros, A. 1926. A new parasitic fungus on mosses. – *Bryologist*, **29**(1): 2-3.
- Brewczyński, P., Grałek, K. & Bilański, P. 2021. Occurrence of the Green Shield-Moss *Buxbaumia viridis* (Moug.) Brid. in the Bieszczady Mountains of Poland. – *Forests*, **12**: 374. <https://doi.org/10.3390/f12030374>
- Deme, J., Erzberger, P., Kovács, D., Tóth, I.Z. & Csiky, J. 2020. *Buxbaumia viridis* (Moug. ex Lam. & DC.) Brid. Ex Moug. & Nestl. in Hungary predominantly terricolous and found in managed forests. – *Cryptog. Bryol.*, **41**(8): 89-103.
- González, I.-I., García, D. & Géne, J. 2021. Novel species of *Cladosporium* from environmental sources in Spain. – *MycKeys*, **77**: 1-25.
- Guillet, A., Hugonnot, V. & Pépin, F. 2021. The habitat of the neglected independent protonemal stage of *Buxbaumia viridis*. – *Plants*, **10**: 83. <https://doi.org/10.3390/plants10010083>
- Györfy, I. 1911. *Novitas cryologica* [sic]. – *Bryologist*, **14**(3): 41-43.
- Hancock, J.A. & Brassard, G. R. 1974. Phenology, sporophyte, production, and life history of *Buxbaumia aphylla* in Newfoundland, Canada. – *Bryologist*, **77**(4): 501-513.
- Hristoff, A. 1934. Some plant disease new for Bulgaria. II contribution. – *Izv. Bulg. Bot. Druz.*, **6**: 1-15. (in Bulgarian)
- Kirk, P.M., Cannon, P.F., Minter, D.W. & Stalpers, J.A. (eds). 2008. *Dictionary of the Fungi*. 10th Edition. CABI.
- Natcheva, R., Ganeva, A. & Spiridonov, G. 2006. Red List of the Bryophytes in Bulgaria. – *Phytol. Balcan.*, **12**(1): 55-62.
- Nedyalkova, S., Stoyanova, Z. & Rodeva, R. 2014. *Cladosporium* leaf spot of durum wheat. – *Science & Technologies*, **4**(6): 274-279. (in Bulgarian)
- Nedyalkova, S., Stoyanova, Z., Georgieva, V., Rodeva, R. 2019. Occurrence and relative prevalence of fungal pathogens on durum wheat. – *International Journal of Innovative Approaches in Agricultural Research*, **3**(3): 442-454.
- Prior, P.V. 1966. A new fungal parasite of mosses. – *Bryologist*, **69**(2): 243-246.
- Schubert, K., Groenewald, J.Z., Braun, U., Dijksterhuis, J., Starink, M., Hill, C.F., Zalar, P., Hoog, G.S. & Crous, P.W. 2007. Biodiversity in the *Cladosporium herbarum* complex (*Davidiellaceae*, *Capnodiales*), with standardization of methods for *Cladosporium* taxonomy and diagnostics. – *Stud. Mycol.*, **58**: 105-156.
- Wolf, T. 2015. Untersuchungen zu den Entwicklungsstadien von *Buxbaumia viridis* (Lam. & DC.) Moug. & Nestl. (Grünes Koldmoos). – *Carolinea*, **73**: 5-15.