Genus *Octospora* (*Ascomycota*, *Pezizomycetes*) in Bulgaria

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Abstract. Eight taxa from the pezizalean genus *Octospora* have been so far reported from Bulgaria. Data on the known distribution in the country are presented. *Octospora gyalectoides* and *O. musci-muralis* var. *musci-muralis* are recorded for the first time in Bulgaria. Concise descriptions and illustrations of the studied specimens are provided. New localities of *O. leucoloma* are also reported. These three *Octospora* taxa are bryoparasitic fungi growing on or among mosses. The associated bryophytes have been identified.

Key words: bryophilous ascomycetes, bryophytes, Bulgaria, new records, *Pezizales, Pyronemataceae*

Introduction

Many bryophilous fungi, and especially bryoparasites growing on or among mosses, belong to the genera *Lamprospora* De Not., *Neottiella* (Cooke) Sacc., *Filicupula* Y. J. Yao & Spooner, *Octospora* Hedw., *Octosporella* Döbbeler, and *Octosporopsis* U. Lindem. & M. Vega (*Pyronemataceae*, *Pezizales*). The genus *Octospora* includes more than 80 species, mostly obligate bryoparasites (Arnolds 1992; Benkert 1993; Döbbeler 1997; Khare 2003; Perry & al. 2007; Kirk & al. 2008; Egertová & al. 2015). *Octospora leucoloma* Hedw. (Dennis & Itzerott 1973) is its type species. The highest number of *Octospora* species has been reported from northern, central and western parts of Europe (Caillet & Moyne 1987; Jakobson & al. 1998; Benkert & Brouwer 2004; Benkert 2007; Egertová & al. 2015).

Eight species from genus *Octospora* have been so far published from Bulgaria. These are: *O. convexula* (Pers.) L. K. Batra, reported as *Humaria convexula* (Pers.) Rehm – Rila Mts (Klika 1926); *O. humosa* (Fr.) Dennis – Mt Vitosha, Pirin Mts, Rila Mts, Western Rhodopi Mts (Aleksandrov 1971; Gyosheva & Denchev 2000; Gyosheva 2003; Dimitrova & Assyov 2004; Dimitrova & Gyosheva 2009); *O. leucoloma* – Valley of River Struma, Eastern Rhodopi Mts (Stoichev & Dimcheva 1987; Stoykov & al. 2015); *O. rubens* (Boud.) M. M. Moser – Mt Vitosha, Mt Sredna Gora (Mt Lozenska) (Aleksandrov 1970, 1971; Hinkova & Aleksandrov 1971; Dimitrova & Gyosheva 2009), and *O. similis* (Kirscht.) Benkert – Rila Mts (Stoykov & al. 2015). Three taxa – *O. axillaris* var. *tetraspora* Benkert, *O. coccinea* (P. Crouan & H. Crouan) Brumm. and *O. musci-muralis* var. *neglecta* (Dennis & Itzerrot) Benkert have been listed as new to Bulgaria by Slavova & Assyov (2017), without data on their localities.

Associated mosses were indicated only for *O. leucoloma* and *O. similis* (Stoykov & al. 2015).

During bryological investigations in different parts of the country, late in autumn and winter of 2017–2018, two new *Octospora* taxa were recorded for Bulgaria: *O. gyalectoides* and *O. musci-muralis* var. *musci-muralis.* They have been collected on mosses by the second author. Furthermore, new localities of another species of the genus, *O. leucoloma,* were also recorded.

Material and methods

Macromorphology of the studied specimens is described on the basis of fresh material. Microscopic examination was held on fresh and air-dried specimens after rehydration in tap water. Micromorphological characters were observed in water under Olympus BX-41, Amplival and Boeco-180/T/SP LM. Amyloidity of the asci and ascospores was tested with Melzer's reagent. All measurements are given as minimum and maximum values, except for the additional data on the spore size of *O. musci-muralis* var. *musci-muralis,* given in the following form: (mean values±1 st. dev.). Spore data measured from 30 ascospores was used. Identification followed Moser (1963), Svrček & Kubička (1963), Dennis & Itzerott (1973), Hansen & Knudsen (2000), Benkert (2007), Eckstein & Eckstein (2009) and Perić (2011). Nomenclature of the *Octospora* taxa is given after Benkert (2009). Bryophyte nomenclature follows Hodgetts (2015). Microphotographs were taken with Olympus E330 and Canon PS A1400HD digital cameras. Macrophotographs were made *in situ.* The studied specimens are kept at the Mycological Collection of the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia (SOMF).

The distribution of *Octospora* taxa with published chorological data in Bulgaria is shown in Fig. 1. Information regarding the associated mosses to *Octospora* known so far in Bulgaria is summarized in Table 3.

Results

Description of the new taxa to the Bulgarian mycota

***Octospora gyalectoides* Svrček & Kubička,** Česká Mykol. 17: 66 (1963) (Plate I, Figs 2-4, Table 1).
Syn. *Inermisia gyalectoides* (Svrček & Kubička) Dennis & Itzerott, Kew Bull. 28(1): 22 (1973)

Ascomata (0.5-)1–1.5 mm in diam, disc-shaped, sessile, hymenium smooth, pale-orange, orange, paler outside, margin narrow. **Asci** 150–175(-190) × 12–15 µm, cylindrical, 8-spored, non-amyloid. **Paraphyses** up to 5-6 µm at the top, clavate, straight or curved towards the apex, with yellow content. **Ascospores** (15–)17.5–21(-22) × 9.5–12(-12.5) µm, ellipsoid, smooth, hyaline, with one large central oil drop (up to 10 µm in diam), uniseriate in the ascus.

Habitat. In open places, grows on mosses. Associated with mosses from family *Pottiaceae* (mostly *Pottia s.l.*, but also *Aloina*, *Barbula*, *Pterygoneurum, Tortella*, *Tortula*), seldom *Bryum*, late autumn-winter (Dennis & Itzerott 1973; Benkert 2007, 2009; Eckstein & Eckstein 2009; Németh 2017). According to Benkert (2007), *O. gyalectoides* infects the stem and leaf cells of the host-moss.

Specimens examined. 1) Thracian Lowland, near Mezek village, on a stone wall, at the entrance to the Mezek Thracian Tomb, four ascomata in cushions of *Tortula muralis* Hedw., *ca* 173 m a.s.l., 15.01.2018, leg. R. Natcheva & D. Ivanova, det. M. Gyosheva (SOMF 29826); 2) Sofia region – Sofia city, Vrana Park, five ascomata on soil, in cushions of *Tortula acaulon* (With.) R.H. Zander, *ca* 550 m a.s.l., 15.03.2018, leg. R. Natcheva, det. M. Gyosheva (SOMF 29830).

General distribution. *O. gyalectoides* was reported so far from northern, central and western parts of Europe: Austria, Czech Republic, France, Germany, Great Britain, Hungary, Nor-

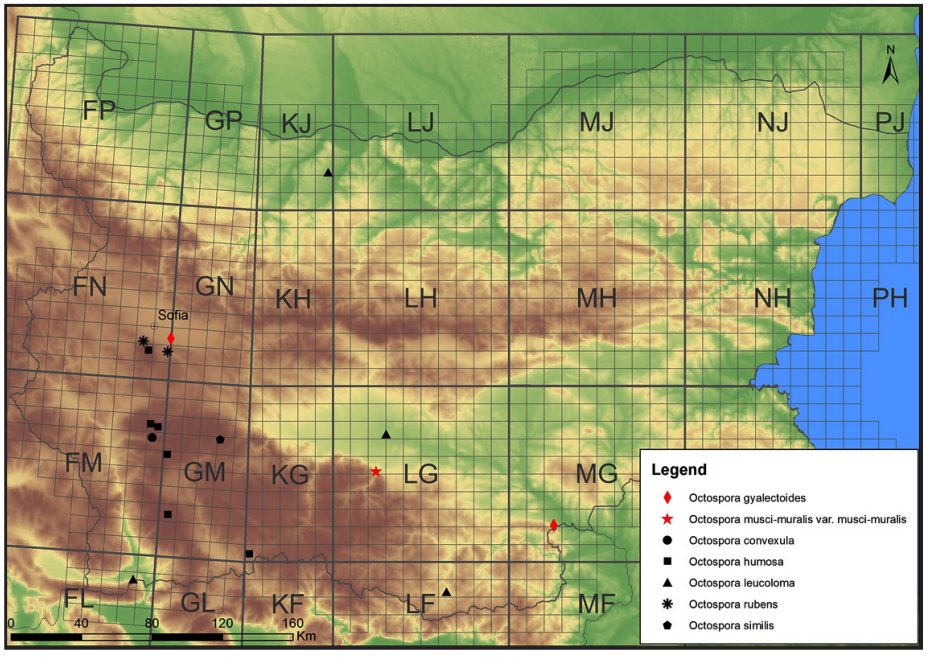


Fig. 1. Distribution of *Octospora* in Bulgaria.

way, and Spain (Dennis & Itzerott 1973; Benkert 2007, 2009; Eckstein & Eckstein 2009; Egertová & al. 2015; Németh 2017). In the Balkans, it is reported (as *Inermisia gyalectoides*) from Turkey (Uzun & al. 2018).

Note. Ascospore measurements of the Bulgarian specimens of *O. gyalectoides* correspond well to the data given by Benkert (2007, 2009), Eckstein & Eckstein (2009) and Uzun & al. (2018). The ascospore size from the original description of the species in Svrček & Kubička (1963) is somewhat smaller. These values of the spore measures were cited by Dennis & Itzerott (1973) in the description of *Inermisia gyalectoides,* and by Hansen & Knudsen (2000). Comparative data of the ascospore size of *O. gyalectoides* are given in Table 1.

Table 1. Ascospore size and associated mosses with *Octospora gyalectoides*, comparative data.

Source	Spore length (µm)	Spore width (µm)	Associated mosses
Svrček & Kubička (1963)	18–21	9–11	on soil
Dennis & Itzerott (1973)	18–21	9–11	*Bryum argenteum, Funaria hygrometrica, Pottia* s.l.
Benkert (2007, 2009)	(15)17–22(23)	9–13	*Barbula* spp., *Pottia* s.l., *Pterygoneurum* spp., *Tortella* spp., *Tortula* spp.
Eckstein & Eckstein (2009)	18–20.8	9–12	*Tortula protobryoides, T. caucasica*
Uzun & al. (2018)	16.5–22	9–12.5	*Pterygoneurum ovatum*
SOMF 29826, 29830 (Bulgaria)	(15)17.5–21(22)	9.5–12(12.5)	*Tortula acaulon, T. muralis*

Table 2. Ascospore size with *Octospora musci-muralis* var. *musci-muralis*, comparative data.

Sources	Spore length (µm)	Spore width (µm)
Graddon (1972)	20–28	8–10.5
Dennis & Itzerott (1973)	20–28	8–10.5
De Meulder (1994)	23.3–28	7.3–9.6
Hansen & Knudsen (2000)	18–25	8–10.5
Perić (2011)	19.5–27	9–10
Khare (2003)	22–30	8–11
Kristiansen (2013)	21–28	9–11
Uzun & al. (2018)	20–25	9–10.5
SOMF 29827 (Bulgaria)	18–26	8–10.5(11)

Table 3. Associated bryophytes with *Octospora* taxa recorded in Bulgaria.

Bryophytes	*Octospora* species
Barbula unguiculata Hedw.	*O. leucoloma*
Grimmia pulvinata (Hedw.) Sm.	*O. musci-muralis* var. *musci-muralis*
Pleuridium acuminatum Lindb.	*O. leucoloma*
Polytrichum piliferum Hedw.	*O. humosa*
Pterygoneurum ovatum (Hedw.) Dixon	*O. leucoloma*
Sarmentypnum exannulatum (Schimp.) Hedenäs	*O. similis*
Tortula acaulon (With.) R.H. Zander	*O. gyalectoides, O. leucoloma*
T. muralis Hedw.	*O. gyalectoides*

Octospora musci-muralis* Graddon var. *musci-muralis, Trans. Br. Mycol. Soc. 58(1): 147 (1972) (Plate I, Figs 5-7, Table 2).

Ascomata up to 1.5–2 mm in diam, disc-shaped, sessile, hymenium smooth, yellowish-orange, bright-orange, margin finely dentate, paler, outher surface pale-orange. **Asci** 150–200 × 15.5–21 µm, clavate, 8-spored, non-amyloid. **Paraphyses** up to 6-8 µm at the top, clavate, curved towards the apex, septate, with granular orange content, greenish in Melzer's reagent. **Ascospores** 18–26 × 8–10.5(-11) µm (22.45±2.2 × 9.87±0.9 µm), Q_{mean} (2.28±0.2), n=30, ellipsoid to subcylindrical, with broadly rounded ends, smooth, hyaline, biguttulate, seldom with one large oil drop, biseriate in the ascus.

Habitat. In cushions of *Grimmia pulvinata* (Hedw.) Sm., on stones (mostly limestone) and mortar walls, in winter (November to February). *O. musci-muralis* infects the rhizoids of the host-moss (Moravec 1968; Dennis & Itzerott 1973; Benkert 1993, 2007, 2009; Eckstein & Eckstein 2009; Perić 2011; Van Vooren 2012; Kristiansen 2013).

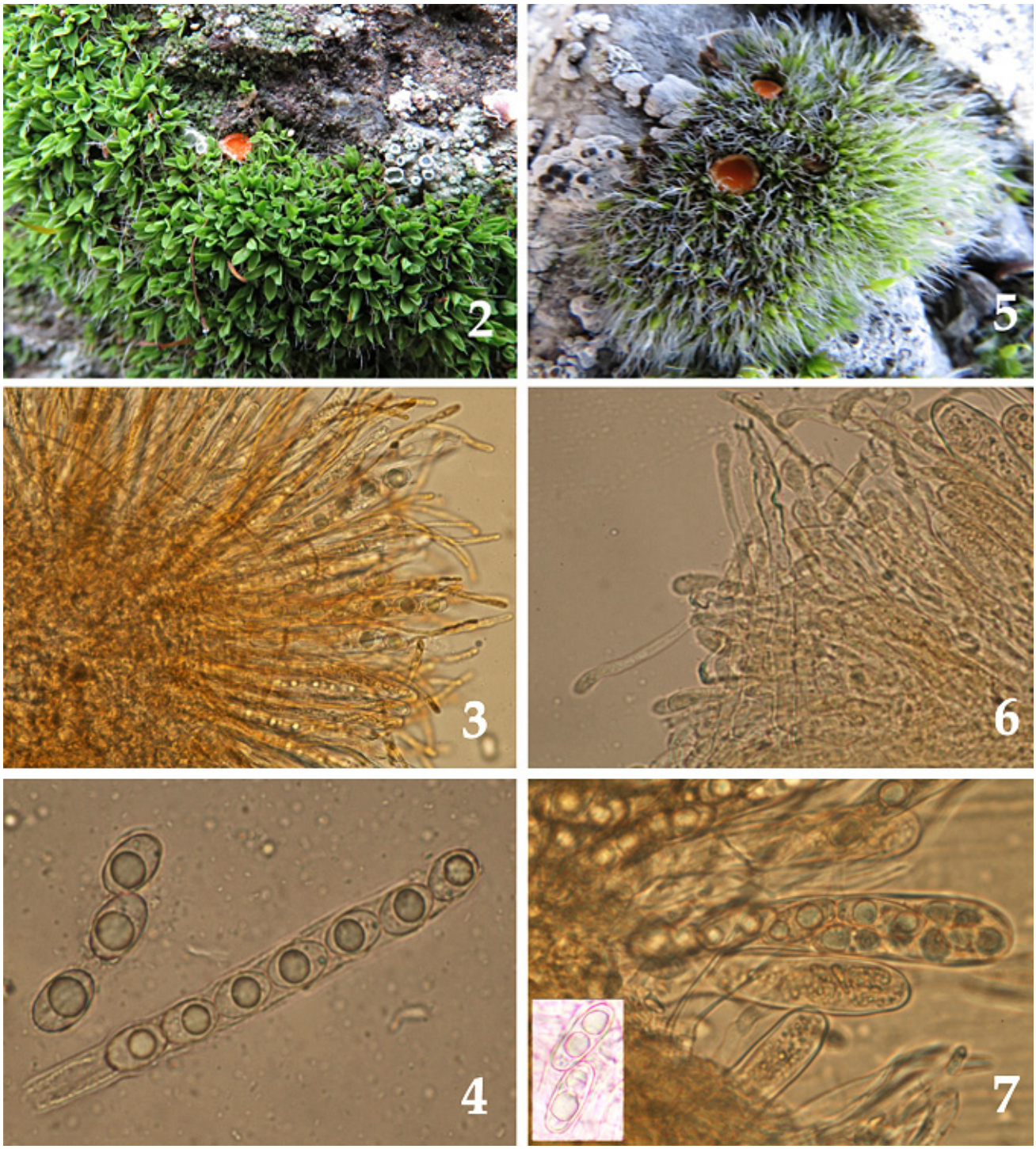
Specimens examined. Central Rhodopi Mts, above Asenovgrad town, on slopes of peak Anatema, on calcareous rock, three ascomata in cushions of *G. pulvinata*, *ca* 415 m a.s.l., 12.12.2017, leg. R. Natcheva, det. M. Gyosheva & D. Stoykov (SOMF 29827).

General distribution. *O. musci-muralis* has been reported from different parts of Europe: Austria, Czech Republic, France, Germany, Great Britain, Hungary, Norway, Spain, and Switzerland (Moravec 1968; Dennis & Itzerott 1973; Benkert 2007, 2009; Eckstein & Eckstein 2009; Perić 2011; Van Vooren 2012; Kristiansen 2013). In the Balkans, it is known from Montenegro (reported as *O. musci-muralis* var. *musci-muralis*) and from Turkey (reported as *O. musci-muralis*) (Perić 2011; Uzun & al. 2018).

Note. *Grimmia pulvinata* is also the host-moss of two other bryoparasitic species from the genus *Octospora: O. grimmiae* Dennis & Itzerott (with smooth, broadly-ellipsoid uniseriate spores, with one large guttula – Dennis & Itzerott 1973) and

O. meslinii (Le Gal) Svrček & Kubička (with finely warted uniguttulate spores – Dennis & Itzerott 1973; Benkert 1993, 2009). *O. musci-muralis* is well distinguished from these species macroscopically and especially microscopically by its smooth, subcylindrical, biguttulate, biseriate spores and by the size of asci and ascospores. The comparative analysis in Table 2 shows that the ascospore size of Bulgarian specimen of *O. musci-muralis* var. *musci-muralis* is closest to the data given by

Plate I.



Octospora gyalectoides: **Fig. 2.** Ascoma *in situ*; **Fig. 3.** Paraphyses, asci and spores; **Fig. 4.** Ascus and spores; *Octospora musci-muralis* var. *musci-muralis*: **Fig. 5.** Ascoma *in situ*; **Fig. 6.** Paraphyses; **Fig. 7.** Asci and spores.

Hansen & Knudsen (2000) and Uzun & al. (2018). Regarding the features of ascospores (ellipsoid to subcylindrical, with broadly rounded ends), *O. musci-muralis* var. *musci-muralis* is very similar to *O. musci-muralis* var. *neglecta* (Dennis & Itzerrot) Benkert. However, the ascospores of var. *neglecta* are 20–29 × 9–13 μm, ellipsoid, usually with one large oil drop, attended by small ones at each end, and its bryophyte hosts are *Schistidium* spp. (Dennis & Itzerott 1973; Benkert 1993, 2009; Perić 2011). For synonymy of *O. musci-muralis* var. *musci-muralis* see Perić (2011: 85).

New localities of *Octospora* species in Bulgaria

Octospora leucoloma Hedw.

Specimens examined. 1) Danubian Plain, near the town of Trastenik, in a pasture, on loess, in cushions of *Tortula acaulon*, *Pterygoneurum ovatum* (Hedw.) Dixon, and *Barbula unguiculata* Hedw., 26.12.2017, leg. R. Natcheva, det. M. Gyosheva, (SOMF 29828); 2) Thracian Lowland, 400 m eastwards from Manole village, in grassy communities, on *T. acaulon*, *ca* 119 m a.s.l., 26.12.2017, leg. R. Natcheva, det. M. Gyosheva, (SOMF 29829).

The species has been reported earlier among *Pleuridium acuminatum* (Stoykov & al. 2015).

Associated mosses with *Octospora* species in Bulgaria

Our studies identified eight associated bryophytes to *Octospora* in Bulgaria. The list of bryophytes with fungal species is given in Table 3. Most bryophytes belong to the family *Pottiaceae* (four species). A wide range of associated mosses (four species) was recorded for *O. leucoloma.* This species grows mostly on *Bryum* spp., especially *B. argenteum* Hedw. Our collections so far were on or among mosses from the genera *Barbula, Pleuridium, Pterygoneurum,* and *Tortula*. Bryophyte hosts of *O. leucoloma*, different from *Bryum* spp. and mentioned above, have been published also by other authors (Dennis 1968; De Meulder 1994; Jakobson & al. 1998; Uzun & al. 2018).

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