

## New Additions to Turkish Pezizales from the Eastern Black Sea Region

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**Abstract:** Ten members of the order Pezizales J.Schröt., namely *Pachyella clypeata* (Schwein.) Le Gal, *Terfezia cistophila* Ant. Rodr., Bordallo, Kaounas & A.Morte (Pezizaceae), *Genea hispidula* Berk. ex Tul. & C.Tul., *Lamprospora campylopodis* W.D.Buckley, *Lamprospora tuberculatella* Seaver, *Octospora grimmiae* Dennis & Itzerott, *Octospora lilacina* (Seaver) Svrček & Kubička, *Pulvinula convexella* (P.Karst.) Pfister, *Ramsbottomia crechqueraultii* (P.Crouan & H.Crouan) Benkert & T.Schumach., and *Trichophaea gregaria* (Rehm) Boud. (Pyronemataceae), are recorded for the first time from Turkey. Brief descriptions and photographs of the taxa are provided.

**Key words:** Biodiversity, new records, Pezizales, Turkey

### 1. Introduction

The order Pezizales is a large group of operculate discomycetes and contains 1683 taxa whose main characteristics are apothecial ascomata, operculate asci, and single-celled spherical to ellipsoidal ascospores (Hansen and Pfister, 2006; Kirk et al., 2008). Pezizaceae and Pyronemataceae are the two most speciose families of this order and they are represented in Turkey by 40 and 81 species, respectively (Sesli and Denchev, 2014; Çolak et al., 2015; Demirel et al., 2015; Güngör et al., 2015a, 2015b; Kaya, 2015; Kaya and Uzun, 2015; Solak et al., 2015; Türkoğlu et al., 2015; Acar and Uzun, 2016; Elliot et al., 2016; Kaya et al., 2016; Çolak and Kaygusuz, 2017; Keleş and Şelem, 2017; Uzun et al., 2017a, 2017b, 2018a, 2018b).

Here we present 10 additional species of Turkish Pezizales, which were collected and determined within the scope of a project carried out in the Eastern Black Sea Region.

The study aims to make a contribution to the mycobiota of Turkey.

### 2. Materials and methods

Fungal specimens were collected from Bayburt, Giresun, Gümüşhane, and Trabzon provinces between 2015 and 2017. The samples were photographed in their natural habitats and the characteristics related to their ecology and morphology were noted. For bryoparasitic taxa, only the host or the accompanying bryophytes were noted and the infection was not studied in detail. An Olympus SZX7 trinocular stereomicroscope was used for examining

some macrostructural properties of smaller fruit bodies. Squash preparations of microscopic structures were mounted in water, congo red, Melzer's reagent, and lactophenol cotton blue, and microscopic examinations were carried out under a Nikon Eclipse Ci-S trinocular light microscope. Spores were measured including the ornaments and at least 20 to 25 spores were measured for each sample. The samples were identified with the help of Seaver (1914, 1942), Gilkey (1939), Hawker (1954), Lange (1956), Pfister (1973), Caillet and Moyne (1980, 1991), Baral et al. (1981), Breitenbach and Kränzlin (1984), Pegler et al. (1993), Yao and Spooner (1995), Benkert (1976, 1987, 1995, 2002), Wang and Kimbrough (1992), Medardi (2006), Eckstein and Eckstein (2013), Beug et al. (2014), Eckstein (2014), and Bordallo et al. (2015). The samples are kept at Karamanoğlu Mehmetbey University, Kamil Özdağ Faculty of Science, Department of Biology.

### 3. Results

The systematics of the taxa is generally given in accordance with *Index Fungorum* ([www.indexfungorum.org](http://www.indexfungorum.org); accessed 30 January 2018). Bryoparasitic taxa are in accordance with *Bryoparasitic Pezizales* (accessed 10 June 2018) and Benkert and Schumacher (1985). The taxa are listed in alphabetical order together with brief descriptions, habitats, localities, collection dates, and voucher numbers.

#### **Pezizaceae** Dumort.

**3.1. *Pachyella clypeata*** (Schwein.) Le Gal, *Revue Mycol.*, Paris 23: 123 (1958) (Figure 1)

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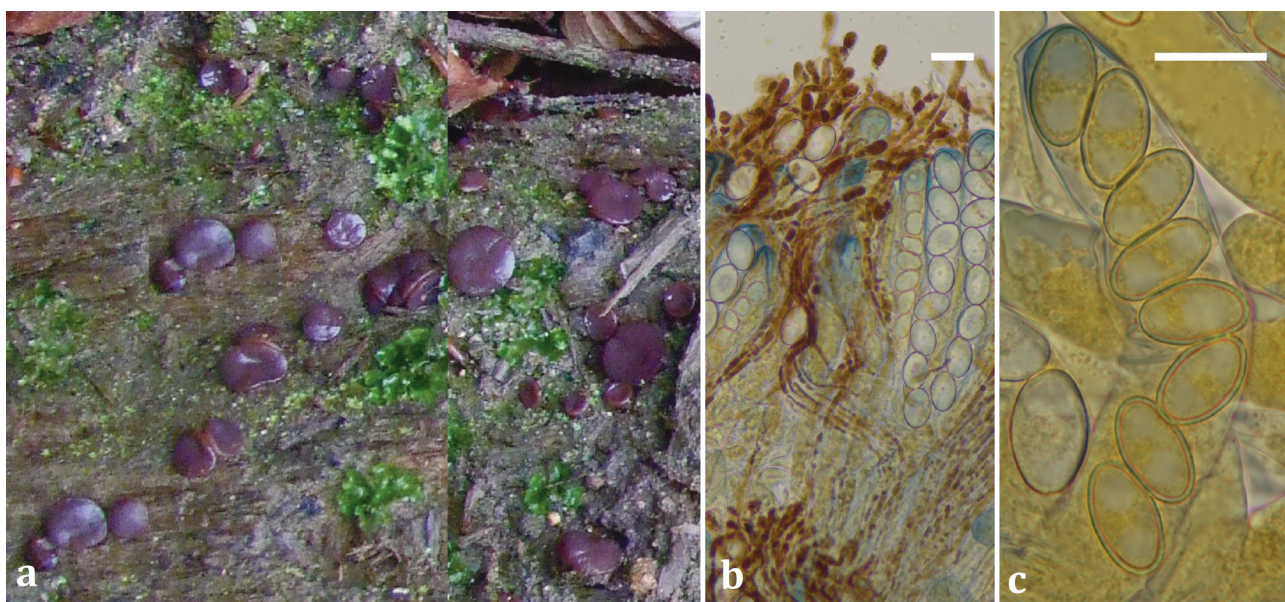
**Macroscopic and microscopic features:** Apothecia 20–50 mm in diameter; sessile; cushion-, saucer-, or flattened cup-shaped; broadly attached to the substrate; hymenial surface sticky when fresh, medium to dark brown or purplish; smooth, wavy, or wrinkled; lower surface grayish to beige. Asci 410–500 × 20–25 μm, cylindrical, with bluish tips in Melzer's reagent, 8-spored. Paraphyses cylindrical, expanded at the tip to 10 μm, generally extended beyond the asci, pigmented with dark, internal amorphous granules especially in the apical part. Ascospores 19–23 × 11.5–15 μm, elliptical, smooth, usually with 2 guttules (Pfister, 1973; Baral et al., 1981).

**Notes:** *P. clypeata* grows on rotten logs and stumps of woods, especially of hardwoods (Pfister, 1973; Baral et al., 1981).

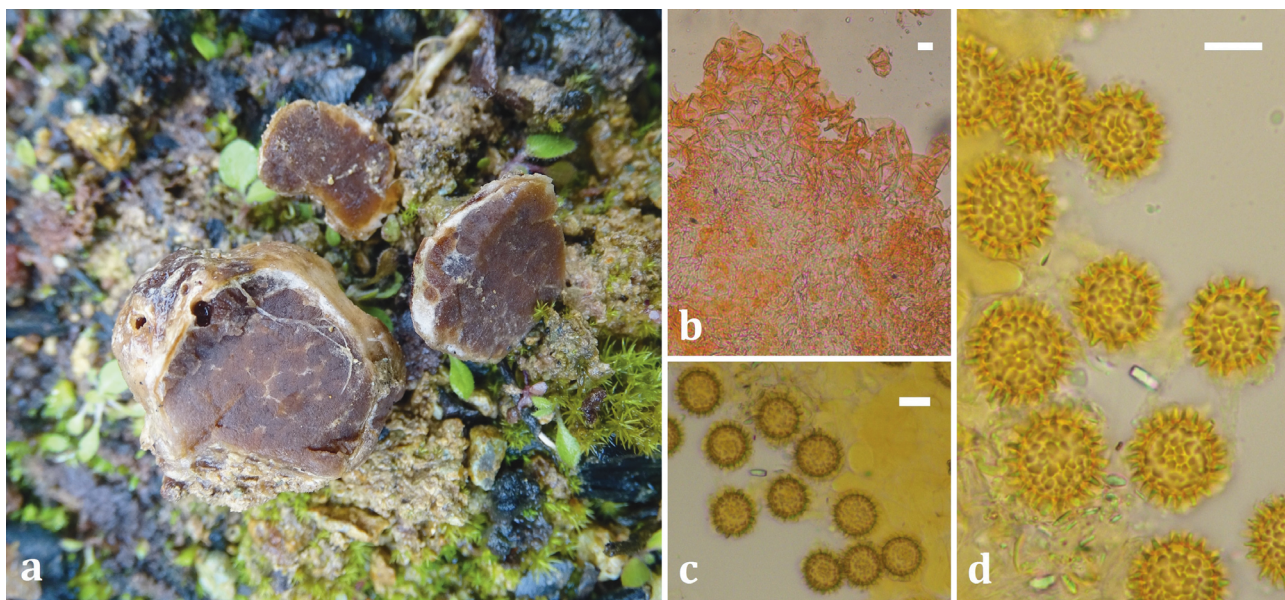
**Specimen examined:** Trabzon, Tonya, Kalınçam village, on stump of hardwoods, 40°46'N, 39°16'E, 1500 m, 21.07.2015, Yuzun 4288.

3.2. *Terfezia cistophila* Ant. Rodr., Bordallo, Kaounas & A.Morte, in Bordallo, Rodríguez, Kaounas, Camello, Honrubia & Morte, Phytotaxa 230(3): 245 (2015) (Figure 2)

**Macroscopic and microscopic features:** Ascocarps 5–20 mm in diameter, hypogeous or partially emergent



**Figure 1.** *Pachyella clypeata*: a- ascocarps, b- asci and paraphyses, c- ascospores (bars: 20 μm).



**Figure 2.** *Terfezia cistophila*: a- mature ascocarp, b- peridial cells, c,d- ascospores (bars: 10 μm).



when mature, globose to subglobose, surface smooth, at first light beige, light brownish to dark reddish brown when mature. Peridium 140–360  $\mu\text{m}$  thick, composed of subglobose cells, thin-walled and hyaline in the innermost layers while thicker walled and yellowish in the outer layers. Gleba solid, fleshy, at first whitish and grayish, then light ochre, brown to pale brown when mature, in some portions, fertile tissues are separated by whitish, sterile veins. Odor spermatic. Asci 55–65  $\times$  45–50  $\mu\text{m}$ , subglobose to ovate, sessile or short-stipitate, 6–8-spored. Ascospores 17–20  $\mu\text{m}$  in diameter, globose, at first hyaline, smooth and uniguttulate, at maturity yellow ochre and ornamented with separate, conical to truncated spines of up to 2.5  $\mu\text{m}$  in length (Bordallo et al., 2015).

**Notes:** *T. cistophila* grows in association with *Cistus monspeliensis* L., *C. creticus* L. (Greece), and *C. ladanifer* L. (Spain) (Bordallo et al., 2015).

**Specimen examined:** Trabzon, Tonya, Kozluca village, under soil with *C. creticus*, 40°56'N, 39°13'E, 1000 m, 27.03.2016, Yuzun 4993.

#### Pyronemataceae Corda

#### 3.3. *Genea hispidula* Berk. ex Tul. & C.Tul., Fungi hypog.: 121 (1851) (Figure 3)

**Macroscopic and microscopic features:** Ascocarp 5–12  $\times$  3–6 mm in diameter, hypogeous, subglobular or depressed, hollow with a circular or broadly elliptical and distinct apical opening, attached by a distinct, basal tuft of mycelium, surface brown, verrucose and covered with long brown hairs, warts generally irregular, hairs up to 600  $\mu\text{m}$  long, thick at the base, become thinner upwards, some forked at the base, septate, thick walled. Flesh whitish to gray. Asci 250–300  $\times$  30–35  $\mu\text{m}$ , cylindrical, 8-spored, spores uniseriate. Paraphyses filiform, septate,

thin-walled, hyaline, become fused and inflated at the apex to form the epithecium. Ascospores 30–42  $\times$  25–30  $\mu\text{m}$ , broadly ellipsoid, covered with coarse, rounded, or somewhat angular tubercles, yellow (Gilkey, 1939; Hawker, 1954; Lange, 1956; Pegler et al., 1993; Beug et al., 2014).

**Notes:** *G. hispidula* grows in the soil or in leaf litter of hardwood forests, rarely under conifers (Beug et al., 2014), under moss, in beech woods (Hawker, 1954), or in association with *Fagus* sp. (Pegler et al., 1993).

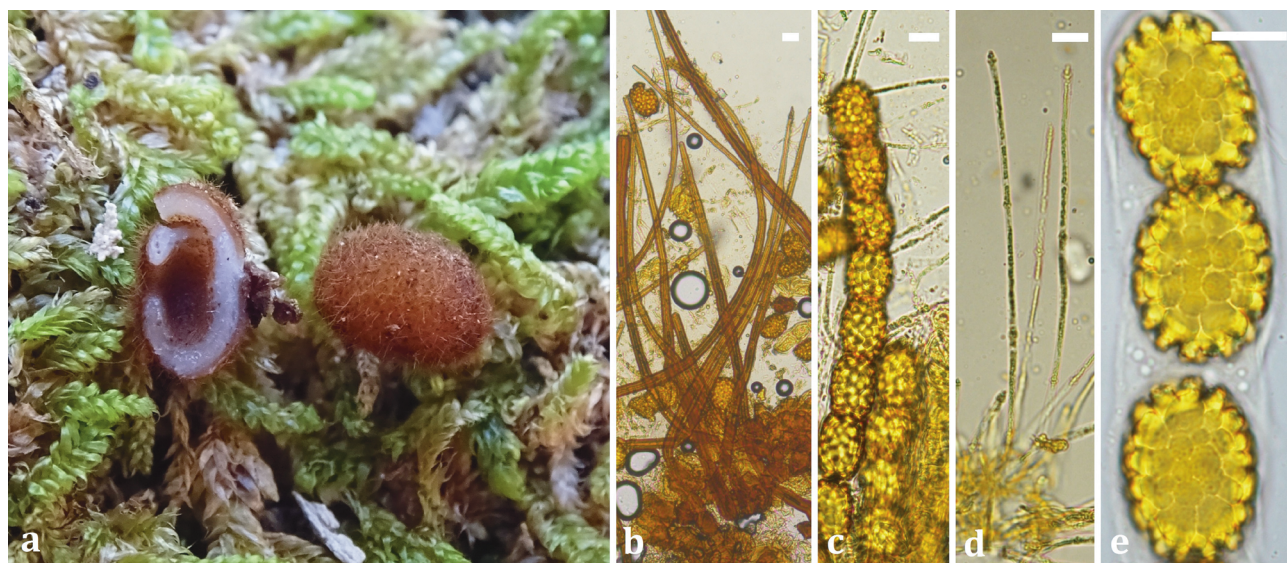
**Specimen examined:** Trabzon, Arsin, Güneyce village, *Fagus orientalis* Lipsky forest, within soil, 40°51'N, 39°55'E, 750 m, 19.10.2017, Yuzun 5916.

#### 3.4. *Lamprospora campylopodis* W.D.Buckley, Trans. Br. mycol. Soc. 9(1-2): 44 (1923) (Figure 4)

**Macroscopic and microscopic features:** Apothecia 0.5–1.5 mm in diameter, discoid, hymenial surface bright orange red, with prominent fimbriate raised margin. Asci 220–320  $\times$  20–25  $\mu\text{m}$ , cylindrical, tapering at the base, do not turn blue in Melzer's reagent, 8-spored, spores uniseriate. Paraphyses cylindrical, slightly enlarged at the apex up to 6–7  $\mu\text{m}$ . Ascospores 14–18  $\mu\text{m}$  in diameter, globose, hyaline, uniguttulate, covered with a ridged ornamentation that forms a more or less regular areolate reticulum (Benkert, 1987; Wang and Kimbrough, 1992; Eckstein and Eckstein, 2013).

**Notes:** *L. campylopodis* was reported to grow among *Campylopus oerstedianus* (Müller Hal.) Mitten and *C. pyriformis* (Schultz) Bridel (Wang and Kimbrough, 1992; Eckstein and Eckstein, 2013).

**Specimen examined:** Trabzon, Tonya, Çayırıcı village, roadside, on moss species *C. pyriformis*, 40°49'N, 39°18'E, 1090 m, 07.11.2016, Yuzun 5406.



**Figure 3.** *Genea hispidula*: a- ascocarp, b- hairs, c- asci, d- paraphyses, e- ascospores (bars: 15  $\mu\text{m}$ ).



3.5. *Lamprospora tuberculatella* Seaver, Mycologia 6(1): 15 (1914) (Figure 5)

**Macroscopic and microscopic features:** Apothecia 0.2–1 mm in diameter, spherical to hemispherical at first, later discoid, convex to flat, hymenial surface smooth, orange to yellowish orange, margin not membranaceous, outer surface concolorous. Asci 170–240 × 16–25 µm, cylindrical, 8-spored, uniseriate, tips do not turn blue in Melzer's reagent. Paraphyses cylindrical, more or less

straight, 3–4 µm in diameter, some very slightly expanded towards the apex. Ascospores 14–18 µm in diameter, globose, smooth at first, then covered with tubercles that are sometimes connected by low strips on the spore surface (Seaver, 1914, 1942; Caillet and Moyne, 1980; Wang and Kimbrough, 1992; Benkert, 2002; Eckstein, 2014).

**Notes:** *L. tuberculatella* grows on the ground among the moss *Didymodon* sp., *Ephemerum* sp., *Weissia* sp., (Eckstein, 2014), and *Pleuridium* sp. (Wang and Kimbrough, 1992).

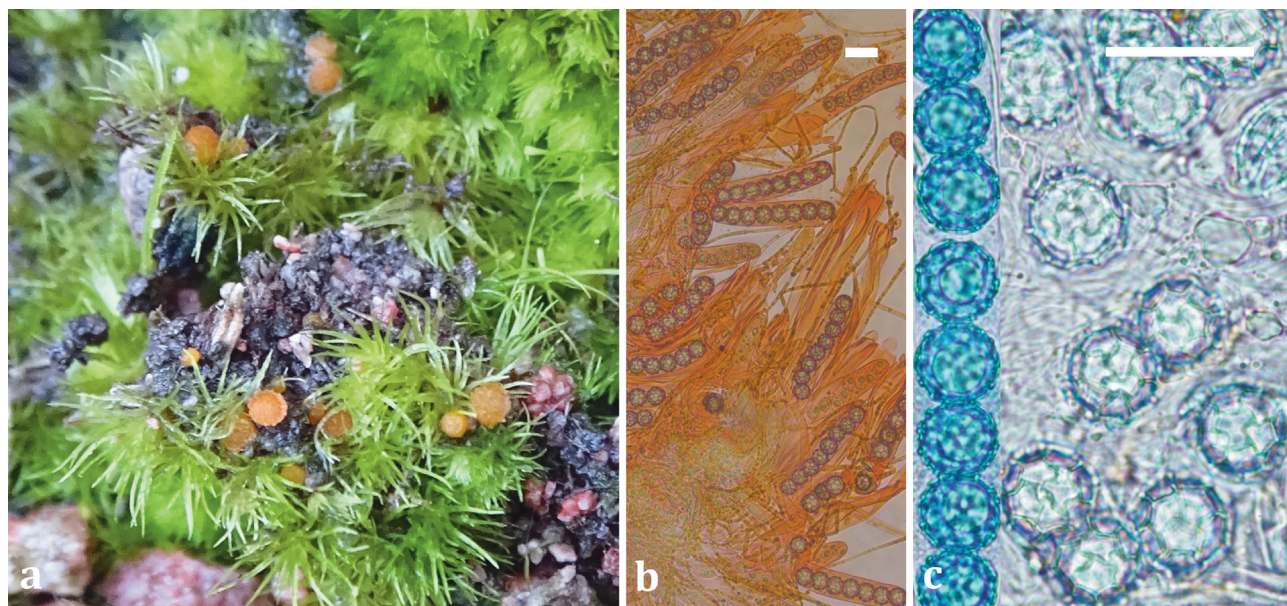


Figure 4. *Lamprospora campylopodis*: a- ascocarps, b- asci and paraphyses, c- ascospores (bars: 25 µm).

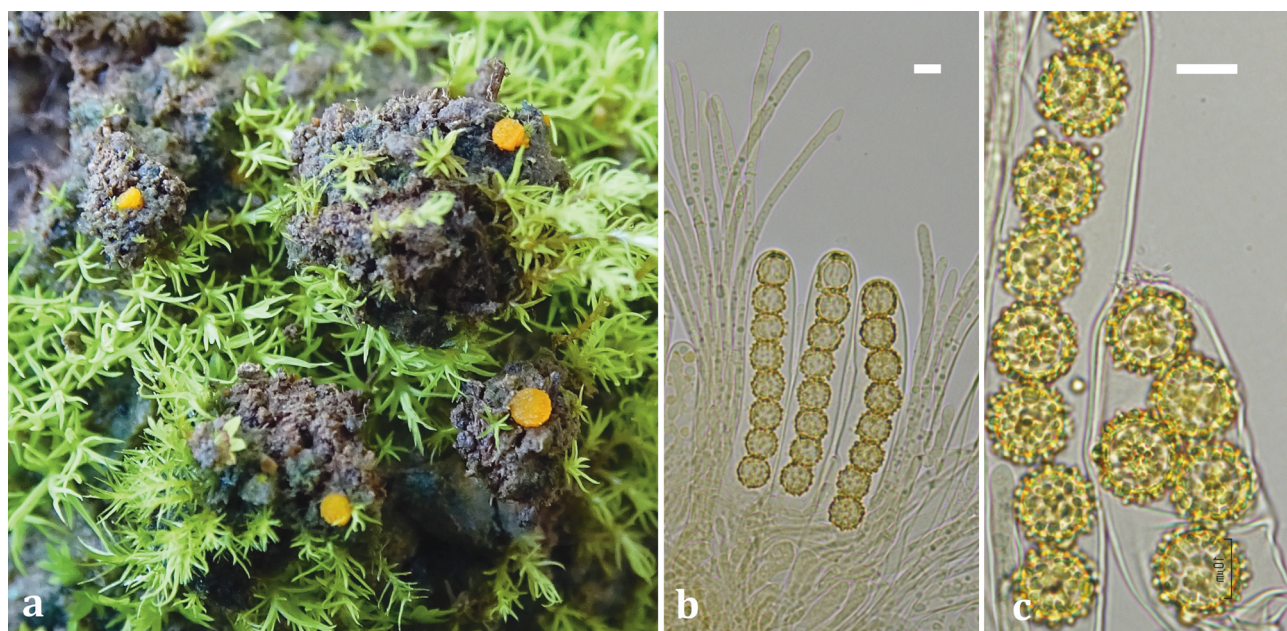


Figure 5. *Lamprospora tuberculatella*: a- ascocarps, b- asci and paraphyses, c- ascospores (bars: 10 µm).



**Specimen examined:** Trabzon, Tonya, Kösecik village, among *Weissia* sp., 40°57'N, 39°16'E, 800 m, 07.11.2016, Yuzun 5395.

**3.6. *Octospora grimmiae*** Dennis & Itzerott, Kew Bull. 28(1): 13 (1973) (Figure 6)

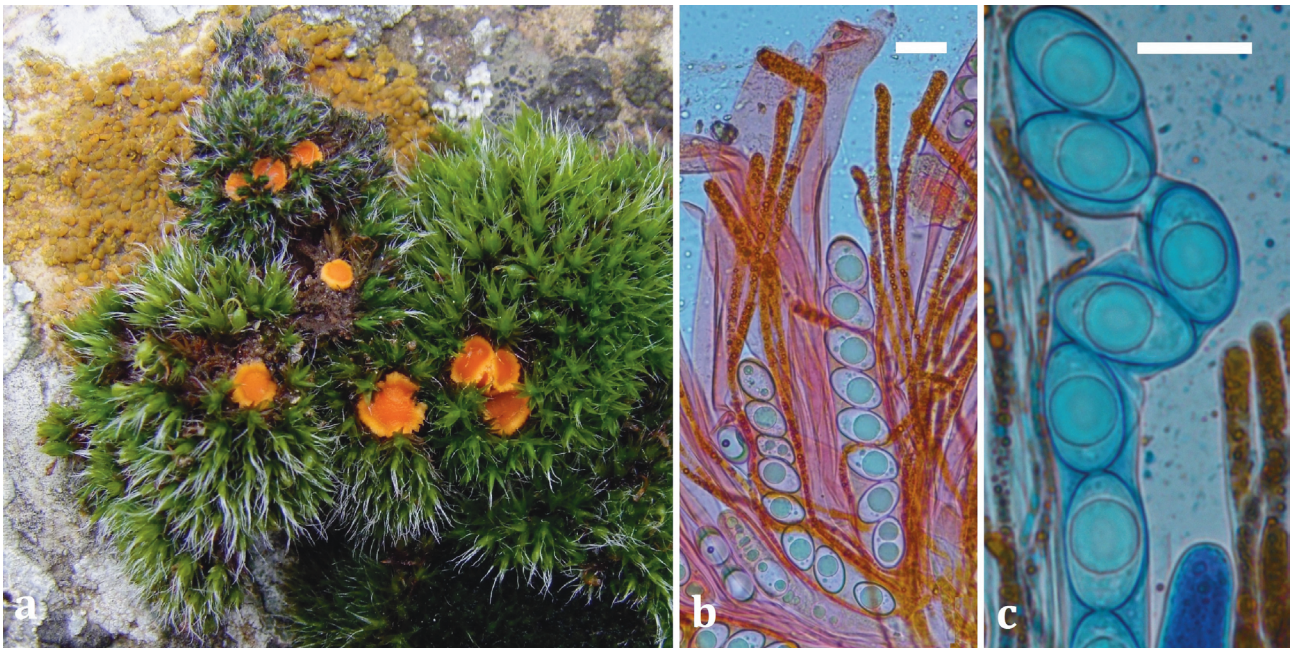
**Macroscopic and microscopic features:** Apothecia 1–2 mm in diameter, cup-shaped, margin membranaceous and dentate, hymenium smooth, orange to reddish. Asci 150–190 × 14–18 μm, cylindrical, 8-spored, spores uniseriate. Paraphyses cylindrical, enlarged toward

the apex up to 7–8 μm. Ascospores 19–24 × 12–14 μm, ellipsoid, smooth, with a large drop (Caillet and Moyné, 1991; Medardi, 2006).

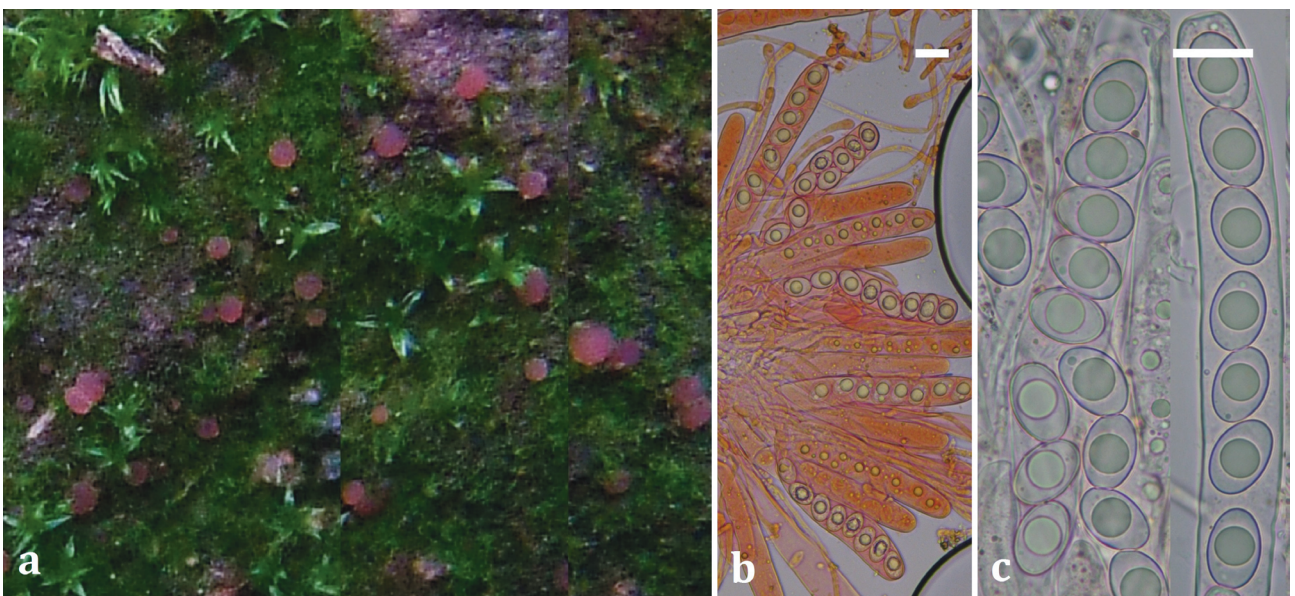
**Notes:** *O. grimmiae* grows in association with cushions of *Grimmia* sp. (Dennis and Itzerott, 1973).

**Specimen examined:** Gümüşhane, Köse, Subaşı village, among *Grimmia pulvinata* (Hedw.) Sm., 40°15'N, 39°34'E, 1875 m, 28.11.2017, Yuzun 5980.

**3.7. *Octospora lilacina*** (Seaver) Svrček & Kubička, Česká Mykol. 17: 65 (1963) (Figure 7)



**Figure 6.** *Octospora grimmiae*: a- ascocarps, b- asci and paraphyses, c- ascospores (bars: 20 μm).



**Figure 7.** *Octospora lilacina*: a- ascocarps, b- asci and paraphyses, c- ascospores (bars: 15 μm).



**Macroscopic and microscopic features:** Apothecia 0.4–1 mm in diameter, at first globose to subglobose, then expands and becomes subdiscoid, at first hymenium concave, then becomes plane or convex, hymenial surface smooth, pale pink to deep lilac, margin not differentiated, outer surface concolorous with the hymenium. Asci 170–200 × 15–17 µm, cylindrical, some tapered at the base, 8-spored, spores generally uniseriate. Paraphyses cylindrical, septate, enlarged towards the apex. Ascospores 14–18 × 9–11 µm, ellipsoid, smooth, usually contain a large and centric or eccentric drop (Seaver, 1942; Benkert, 1995).

**Notes:** *O. lilacina* was reported as *Humarina lilacina* Seaver to grow among mosses and algae (Seaver, 1942).

**Specimen examined:** Trabzon, Tonya, İskenderli village, roadside, on moss-in moss-protonema, 40°55'N, 39°14'E, 750 m, 23.07.2015, Yuzun 4376.

**3.8. *Pulvinula convexella*** (P.Karst.) Pfister, Occ. Pap. Farlow Herb. Crypt. Bot. 9: 9 (1976) (Figure 8)

**Macroscopic and microscopic features:** Apothecia 2–9 mm in diameter, sessile to very shortly stipitate, cushion-shaped to subdiscoid, seldom weakly concave, hymenial surface smooth, orange to orange-yellow, underside concolorous or slightly lighter. Flesh waxy, yellow orange. Asci 220–250 × 20–25 µm, cylindrical, operculate, 8-spored, spores uniseriate. Paraphyses cylindrical to filiform, forked, not septate, bent at the apex like a cane. Ascospores 14–18.5 µm in diameter, globose to spherical, generally with a large drop that almost filled the whole spore lumen, smooth, hyaline (Seaver, 1942; Breitenbach and Kränzlin, 1984; Medardi, 2006; Beug et al., 2014).

**Notes:** *P. convexella* was reported to grow on sandy and humid soil along streams or paths, especially on burned ground (Medardi, 2006; Beug et al., 2014).

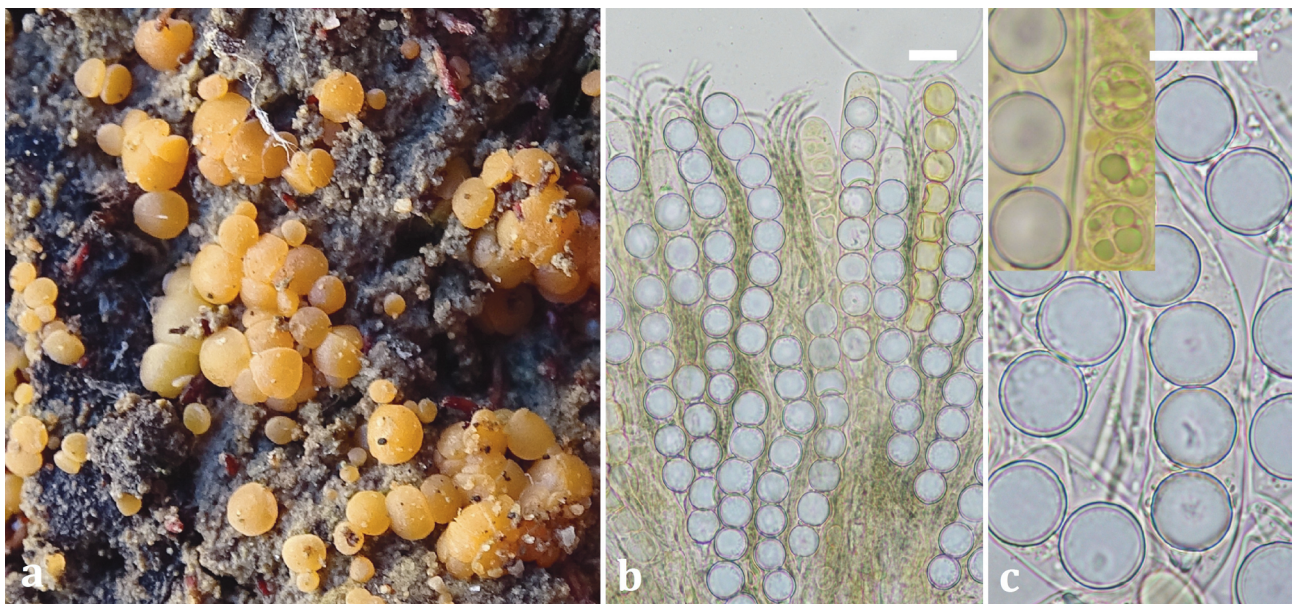
**Specimen examined:** Gümüşhane, Torul, city center, near the stream, on sandy soil, 40°33'N, 39°17'E, 925 m, 10.09.2017, Yuzun 5818; Bayburt, central district, Tepetarla village, under *Salix* sp. and *Populus* sp., near the stream, on sandy soil, 40°18'N, 40°16'E, 1175 m, 17.10.2017, Yuzun 5887.

**3.9. *Ramsbottomia crechqueraultii*** (P.Crouan & H.Crouan) Benkert & T.Schumach., *Agarica* 6(12): 33 (1985) (Figure 9)

**Macroscopic and microscopic features:** Apothecia 2–5 mm in diameter, shallowly cup- to saucer-shaped, sessile or with a rudimentary stalk, hymenial surface smooth, pale orange to pale orange-yellow, margin even and almost indistinct; outer surface smooth, concolorous with the hymenium or paler. Asci 300–325 × 25–27 µm, cylindrical to subcylindrical, 8-spored, spores uniseriate. Paraphyses straight, septate, hyaline, enlarged at the tip. Ascospores 15–19 µm, subglobose to globose, hyaline, smooth and with many small oil drops when young, ornamented with sharply pointed spines 2–3.9 µm long when mature (Seaver, 1914; Benkert, 1976; Caillet and Moyne, 1980; Yao and Spooner, 1995; Medardi, 2006; Beug et al., 2014).

**Notes:** *R. crechqueraultii* was reported to grow on bare ground and on logs of *Betula papyrifera* Marshall among mosses or *Carex* sp. (Povah, 1931; Kullman and Brummelen, 1992; Beug et al., 2014).

**Specimen examined:** Trabzon, Tonya, İskenderli village, roadside, on soil with mosses, 40°55'N, 39°14'E,



**Figure 8.** *Pulvinula convexella* (Yuzun 5818): a- ascocarps, b- asci and paraphyses, c- ascospores (bars: 20 µm).



750 m, 23.07.2015, Yuzun 4386; Sayraç village, 40°54'N, 39°14'E, 900 m, 23.07.2015, Yuzun 4392.

3.10. *Trichophaea gregaria* (Rehm) Boud., Hist. Class. Discom. Eur. (Paris): 160 (1907) (Figure 10)

**Macroscopic and microscopic features:** Apothecia 4–10 mm in diameter, sessile, hemispherical when young, then cup- to dish-shaped when mature, hymenial surface grayish-white to gray, smooth, margin ciliated

and remaining upward, outer surface brownish, densely covered with dark-brown hairs which are thick-walled, septate, and tapering toward the apex. Flesh whitish and fragile. Asci 180–220 × 12–15 µm, cylindrical, 8-spored, spores uniseriate. Paraphyses cylindrical, septate, slightly enlarged toward the apex. Ascospores 23–25 × 9–10 µm, narrowly elliptical to subfusiform, smooth, hyaline with a central large guttule or many small ones (Breitenbach and Kränzlin, 1984; Medardi, 2006).

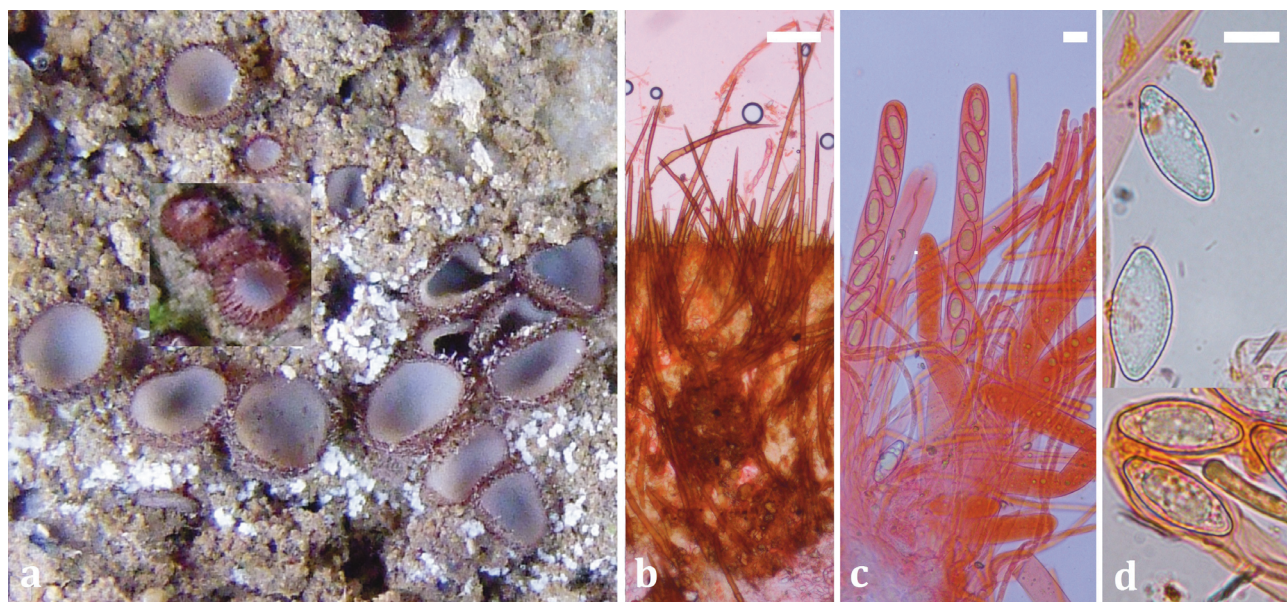


Figure 9. *Trichophaea gregaria*: a- ascocarps, b- hairs, c- asci and paraphyses, d- ascospores (bars: b- 100 µm c,d- 15 µm).

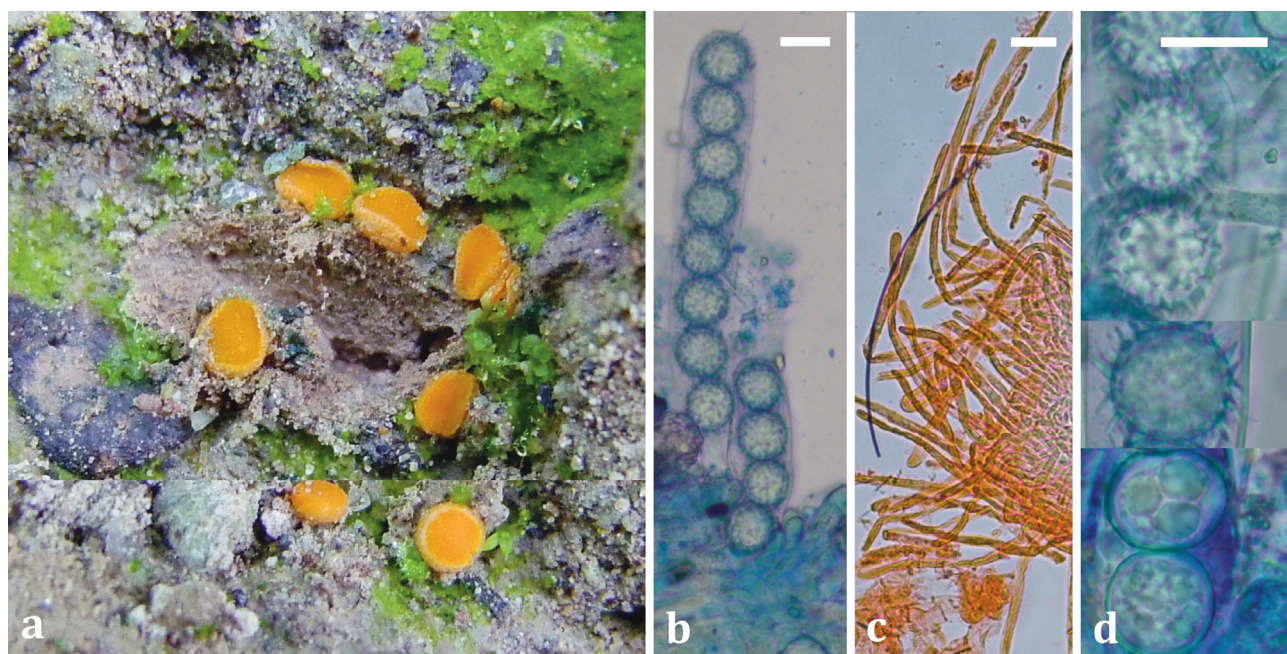


Figure 10. *Ramsbottomia crechqueraultii* (Yuzun 4392): a- ascocarps, b- asci, c- paraphyses, d- ascospores (bars: 15 µm).

**Notes:** *T. gregaria* grows on bare sandy and mossy soil (Medardi, 2006) as well as on burned places (Breitenbach and Kränzlin, 1984).

**Specimen examined:** Trabzon, Tonya, Kalınçam village, roadside, on soil, 40°46'N, 39°16'E, 1500 m, 21.07.2015, Yuzun 4318.

#### 4. Discussion

More than 200 species of Pezizales are currently known from Turkey. One hundred twenty-one of them belong to the families Pezizaceae and Pyronemataceae. With the present study, two members of Pezizaceae and eight members of Pyronemataceae were added to Turkish Pezizales as new records. All characteristics of the determined species are generally in agreement with those given in the literature.

The fruit body of *P. clypeata* is larger than that of the other members of the genus *Pachyella* Boud. Although it has some similarities with *P. violaceonigra* (Rehm) Pfister, *P. adnata* (Berk. & M.A.Curtis) Pfister, and *P. megalosperma* (Le Gal) Pfister, it is easily distinguished by its smooth spores (Pfister, 1973).

*Terfezia cistophila* has spiny spores and grows in acid soils in association with *Cistus* sp. Although *T. fanfanii* Mattir., *T. pseudoleptoderma* Bordallo, Ant. Rodr. & Muñ.-Moh., *T. extremadurensis* Muñ.-Moh., Ant. Rodr. & Bordallo, *T. pini* Bordallo, Ant. Rodr. & Muñ.-Moh., and *T. leptoderma* (Tul. & C.Tul.) Tul. & C.Tul. also have spiny

spores, the shorter spines, the distinct spermatic odor, and association with *Cistus* spp. differentiate *T. cistophila* from the others (Bordallo et al., 2015).

The spore ornamentation of *L. campylopodis* is similar to that of *L. miniata* De Not., but the smaller apothecium and the larger spores distinguish it from the latter species (Wang and Kimbrough, 1992).

Both *L. tuberculata* Seaver and *L. tuberculatella* have ornamented spores with tubercles. However, the tubercles on the latter species are distinctly smaller. Egertova et al. (2015) reported the occurrence of *L. tuberculatella* on the members of *Didymodon*, *Ephemerum*, *Weissia*, and *Paraleucobryum*, while *L. tuberculata* is known to be parasitic on *Pleuridium*.

*Pulvinula convexella* is similar to *P. archeri* (Berk.) Rifai in terms of color, habitat, and morphology, but it has small spores of 8.5–11.5 µm. Likewise, *T. gregaria* resembles *T. woolhopeia* (Cooke & W.Phillips) Boud. in terms morphology, but the habitat (sandy ground) and narrower spores distinguish it from the latter species (Breitenbach and Kränzlin, 1984).

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