

Lichenicolous fungi in Iğdır province, Turkey

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ABSTRACT

As a result of lichenological exploration in the province of Iğdır, Turkey, forty species of lichenicolous fungi belonging to eighteen genera were identified on twenty-seven different lichenized fungi. Four lichenicolous fungi—*Arthonia protoparmeliopsis*, *Lichenostigma radicans*, *L. subradicans* and *Sclerococcum sphaerale*—represent new records for Turkey. In addition, *A. protoparmeliopsis* is new to Asia and *Gemmaspora lecanorae* was found for the second time on *Aspicilia* sp. Geographical distributions are also presented.

Key words: Ascomycetes, lichens, new records, taxonomy

Introduction

Although lichenicolous fungi of Turkey have been the subject of a number of recent studies (Candan & Halici 2009; Etayo & Yazici 2009; Yazici *et al.* 2010a, 2010b, 2010c; Yazici *et al.* 2011a, 2011b, 2012; Halici *et al.* 2010, 2012; Halici & Aksoy 2009), knowledge of such fungi is still insufficient. To date, 139 lichenicolous fungal taxa have been found in Turkey (Yazici *et al.* 2011b). This number is small when compared with those of some better studied European countries (Fałtynowicz 2003; Hawksworth 2003; Hawksworth & Cole 2002; Kocourková 2000; Santesson *et al.* 2004; Scholz 2000). Therefore, additional studies are needed in order to increase the knowledge of lichenicolous fungi in Turkey.

No lichenicolous fungi have thus far been reported for the Iğdır province, although 14 lichens have been recorded for the region (Aptroot & Yazici 2012; Vondrák *et al.* 2012; Yazici *et al.* 2012; Yazici *et al.* 2011c). In this paper, we report four lichenicolous fungi that represent new records for the Iğdır region and for Turkey.

Material and methods

Collection sites

During lichenological field studies carried out between 28 March 2010 and 14 June 2011, specimens were collected from 41 sites within the Iğdır region (Tab. 1). Lichenicolous fungi species were collected from an area near the capital city of Iğdır (central Iğdır province), as well as from the

districts of Tuzluca, Aralık, Karakoyunlu (Fig. 1). The province of Iğdır is in eastern Turkey, bordering Armenia, Nakhchivan and Iran. The adjacent provinces are Kars to the northwest and Ağrı to the west and south. Iğdır occupies an area of 3587 km² and has a population of 184,418 (Fig. 1).

The Iğdır province, where the vegetation is comprised primarily of grassy plants, is one of several poorly forested areas of mainly steppe in Turkey. In northern and southeastern Iğdır, in the Karakoyunlu and Aralık districts, as well as to the north and east of the Tuzluca district, there are many treeless grassy plains. The area is sunny, windswept and open. The gently sloping terrain features streams and grassy areas, with calcareous and siliceous rocks. Some of the mountains, including Ağrı, Zordağ, Tekaltı, Oyuklu and Ziyaret, which are exposed to intense light conditions, are also dominated by grass, rocks (siliceous and calcareous) and streams, with scattered coniferous and deciduous trees, such as *Elaeagnus*, *Populus*, *Prunus*, *Pyrus* and *Salix* (Baytop & Denizci 1963).

According to Baytop & Denizci (1963), *Prunus*, *Pyrus*, *Populus*, *Salix*, and *Elaeagnus* trees occur occasionally along the streams in many villages, such as Köprübaşı and Sürmeli (in the Tuzluca district); Saraçlı, Aşağı Çamurlu, Hasanhan, Babacan and Aşağı Topraklı (in the Aralık district); and Gökçeli, Cennetabat and Bayatdoğanşalı (in the Karakoyunlu district). Calcareous and siliceous rocks are seen in many villages in the southern parts of the Iğdır region. Very few lichen and lichenicolous fungi species were seen in some villages, especially along Aras River, which forms the border with Armenia in the north of Iğdır.

In the villages of Bulakbaşı, Yazlık, Aktaş, İslamköy and Adetli, located on the northern slopes of Ağrı Mountain,

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Table 1. Collection sites in Iğdır province, Turkey.

No.	District: site	Coordinates	Altitude (m)	Date
1	Iğdır: alongside the main Iğdır-Doğubeyazıt road (12 km from Iğdır city)	39°50'43.69"N; 44°04'43.70"E	914	28 Mar., 2010
2	Iğdır: center, 10 km west of Iğdır, 16 km in from the Yukarı Çarıklı village turnoff, on the roadside, in Hoşhaber village	39°51'56.08"N; 43°56'52.60"E	1181	29 Mar., 2010
3	Iğdır: Bendemurat village	39°47'16.06"N; 43°57'30.14"E	2121	16 Jul., 2010
4	Iğdır: Gülpınar village	39°47'17.30"N; 44°00'41.35"E	1609	16 Jul., 2010
5	Iğdır: South of Halfeli	39°52'32.84"N; 43°57'28.53"E	1028	29 Mar., 2010
6	Iğdır: Korhan plateau, roadside (hillside of Ağrı Mountain)	39°47'46.07"N; 44°14'10.72"E	2072	28 Mar., 2010
7	Iğdır: Örüsmüş village	39°47'36.03"N; 43°58'16.84"E	1945	16 Jul., 2010
8	Iğdır: Pınarbaşı Köyü village	39°49'08.37"N; 43°47'08.97"E	1843	13 Jul., 2010
9	Iğdır: Taşlıca village	39°50'00.37"N; 43°47'48.56"E	1704	13 Jul., 2010
10	Iğdır: Zor Mountain	39°45'49.05"N; 43°53'20.13"E	2400	13 Jun., 2010
11	Iğdır: Asma village	39°47'49.70"N; 43°48'35.53"E	1868	13 Jul., 2010
12	Aralık: Bilican village	39°41'12.81"N; 44°24'16.11"E	2320	14 Jun., 2011
13	Aralık: Gömük village	39°42'17.36"N; 44°24'13.63"E	2198	14 Jun., 2011
14	Aralık: Tarlabası village	39°47'4.22"N; 44°24'17.25"E	1421	14 Jun., 2011
15	Aralık: between the villages of Karakoyunlu and Melekli, 200-250 m off the main road	39°57'30.50"N; 44°08'58.02"E	860	30 Mar., 2010
16	Karakoyunlu: Taşburun village, 300 m off the main road	39°58'01.68"N; 44°14'08.40"E	860	30 Mar., 2010
17	Karakoyunlu: Aktaş village	39°55'09.12"N; 44°16'04.34"E	828	14 Jun., 2011
18	Karakoyunlu: Yazlık village	39°54'38.48"N; 44°16'53.91"E	830	14 Jun., 2011
19	Karakoyunlu: Korhan plateau (area surrounding the gendarmerie headquarters)	39°47'11.09"N; 44°16'06.73"E	1904	17 Jun., 2010
20	Karakoyunlu: Ağrı Mountain	39°45'18.86"N; 44°16'12.52"E	3191	29 Jul., 2011
21	Karakoyunlu: Bulakbaşı village	39°56'13.89"N; 44°15'30.49"E	832	14 Jun., 2011
22	Tuzluca: Taşucan village	39°51'26.61"N; 43°35'41.06"E	3168	2 Jul., 2010
23	Tuzluca: between the villages of Yukarı Civanlı and Aşağı Civanlı	40°00'31.57"N; 43°32'526.37"E	1882	16 Jun., 2010
24	Tuzluca: Aşağı Aktaş village (monument tomb and roadside)	40°04'45.42"N; 43°31'34.61"E	1538	5 Jul., 2010
25	Tuzluca: Bahçelimeydan village	40°03'50.07"N; 43°27'01.70"E	1328	12 Jul., 2010
26	Tuzluca: Güllüce village	39°53'29.26"N; 43°39'33.47"E	1769	15 Jun., 2010
27	Tuzluca: Gaziler village	40°05'02.40"N; 43°26'55.40"E	1116	3 Jul., 2010

Continues

Table 1. Continuation.

No.	District: site	Coordinates	Altitude (m)	Date
28	Tuzluca: Tekaltı Mountain	40°01'57.22"N; 43°33'12.89"E	2257	4 Jul., 2010
29	Tuzluca: on the Tuzluca-Kağızman border, alongside the main road, at the Aşağı Aktaş village turnoff	40°06'27.27"N; 43°30'16.05"E	1055	31 Mar., 2010
30	Tuzluca: along the roadside in the villages of Bahçecik and Bahçeçik	40°04'05.63"N; 43°25'35.47"E, 40°04'27.27"N; 43°25'06.12"E	1693, 1754	12 Jul., 2010
31	Tuzluca: İnceköy village	39°53'17.06"N; 43°38'09.44"E	1777	2 Jul., 2010
32	Tuzluca: between the villages of Uğurca and Yukarı Civanlı	40°00'03.72"N; 43°26'25.80"E	2056	16 Jun., 2010
33	Tuzluca: Göktaş village, roadside	39°59'52.55"N; 43°33'55.78"E	1489	16 Jun., 2010
34	Tuzluca: 1 km from Çıraklı village, roadside	40°03'53.89"N; 43°29'32.98"E	1428, 1571	3 Jul., 2010
35	Tuzluca: between the villages of Ağaçlı and Bağlan, roadside	39°54'51.67"N; 43°39'07.05"E	1727	2 Jul., 2010
36	Tuzluca: between the villages of Taşköprü and Karacaköyü	39°52'07.40"N; 43°28'50.94"E	2134	14 Jun., 2010
37	Tuzluca: 2 km from Canderviş village, roadside	39°56'23.67" N; 43°30'09.63"E	2189	16 Jun., 2010
38	Tuzluca: Ünlendi village	39°53'49.48"N; 43°33'38.86"E	1949	14 Jun., 2010
39	Tuzluca: 3 km from Taşköprü village and 3 km from Kandilli village, roadside	39°51'25.16"N; 43°27'33.13"E	2240	14 Jun., 2010
40	Tuzluca: Kula village, roadside	40°51'4.25"N; 43°25'53.48"E	1175	12 Jul., 2010
41	Tuzluca: Ziyaret Mountain	40°02'51.06"N; 43°24'33.22"E	2101	24 Jun., 2011

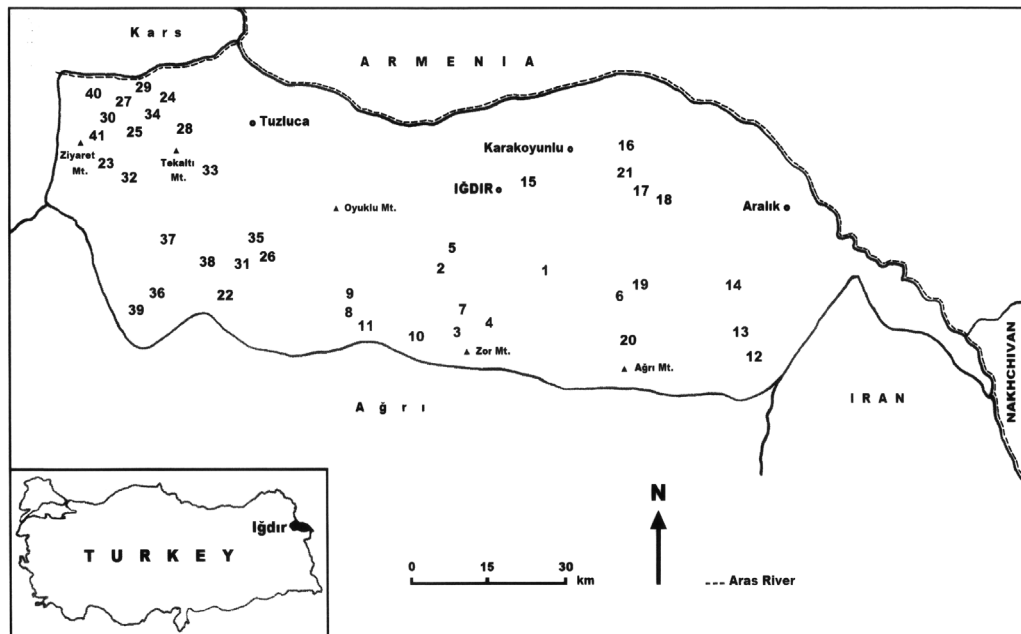


Figure 1. Map of Iğdır province (Turkey), showing the sites* at which lichenicolous fungi were collected.
*Numbering corresponds to Tab. 1.

there are few deciduous or coniferous trees. In those villages, especially those on the Korhan plateau, the rocks are predominantly volcanic. At an elevation of 2000-3200 m, we observed mostly crustose lichens on volcanic rocks. On the Korhan plateau, the tree population is very poor, comprising only certain deciduous trees, such as *Betula* and *Populus*. Therefore, the population of lichen and lichenicolous fungi on the body of trees is poor, with little biodiversity.

The climate in the Iğdır region is characterized by hot, dry summers and cold, snowy winters. The mean annual temperature is 11.6°C, with a mean annual humidity of 63% and a mean annual rainfall of 257.6 mm (Akman 1999).

Collection, storage and processing of samples

Hand-cut sections were microscopically examined in water (including all measurements), 10% potassium hydroxide or lactophenol cotton blue. Air-dried samples were observed and studied with a Nikon SMZ1500 stereomicroscope and a Nikon Eclipse 80i light microscope (Nikon, Tokyo, Japan). Descriptions of the species are based on the materials collected from the area and on data in the literature. Nomenclature and species concepts follow Atienza *et al.* (2003), Hawksworth (2003), Santesson *et al.* (2004), Halici *et al.* (2007), Etayo & Sancho (2008), Etayo & Navarro-Rosinés (2008) and Navarro-Rosinés *et al.* (2009). Voucher specimens were stored in the Herbarium of the Biology Department, Faculty of Science, Karadeniz Technical University, Trabzon, Turkey (KTUB).

Results

Within the study area, we identified the following species:

Arthonia clemens (Tul.) Th. Fr. – Iğdır: [Loc. 10], (KTUB 2357); [Loc. 32], (KTUB 2354); [Loc. 38], (KTUB 2356), on the apothecia of *Rhizoplaca chrysoleuca*.

Arthonia epiphyscia Nyl. – Iğdır: [Loc. 11], (KTUB 2116), on the thallus of *Physcia dubia*; [Loc. 2], (KTUB 2119); [Loc. 23], (KTUB 2111); [Loc. 22], (KTUB 2118); [Loc. 30], (KTUB 2104), on the thalli of *Physcia biziana*.

Arthonia hawksworthii Halici – Iğdır: [Loc. 20], (KTUB 2106); [Loc. 9], (KTUB 2220), on the thallus of *Dimelaena oreina*.

Arthonia molendoi (Heufl. ex Frauenf.) R. Sant. – Iğdır: [Loc. 29], (KTUB 2112); [Loc. 18], (KTUB 2115); [Loc. 30], (KTUB 2113); [Loc. 21], (KTUB 2117); [Loc. 12], (KTUB 2223), on the thalli and apothecia of *Xanthoria elegans*.

Arthonia phaeophysciae Grube & Matzer – Iğdır [Loc. 20], (KTUB 2225), on the thallus of *Phaeophyscia sciastra*.

Arthonia protoparmeliopsisidis Etayo & Diederich – Iğdır: [Loc. 32], (KTUB 2114), on the discs of apothecia of *Lecanora muralis*; mixed with *Cercidospora macrospora*. This species was described in detail by Etayo & Diederich (2009). Previously known from Spain and Luxembourg. New to Turkey and Asia. Ascomata single or grouped, large

and blackish, roughly convex, round or irregular in shape, immersed in the thallus or apothecial discs; asci 8-spored, claviform or ellipsoid, wall thickened with an ocular chamber, 22.0-42.0 × 10.0-15.0 µm; ascospores 2- to 3-septate, ellipsoid, colorless, thin-walled, slightly constricted at the septa, perispore thin, 10.0-15.0 × 3.5-6.0 µm. Hymenium pale brown, I+ red, 45.0-50.0 µm tall. Epithymenium brown or olive brown, K+ olive-green.

Caloplaca grimmiae (Nyl.) H. Olivier – Iğdır: [Loc. 6], (KTUB 2107); [Loc. 1], (KTUB 2110); [Loc. 10], (KTUB 2221); [Loc. 7], (KTUB 2109); [Loc. 4], (KTUB 2108); [Loc. 3], (KTUB 2222); [Loc. 12], (KTUB 2224); [Loc. 14], (KTUB 2108); [Loc. 21], (KTUB 2119); [Loc. 18], (KTUB 2228); [Loc. 17], (KTUB 2226); [Loc. 20], (KTUB 2229); [Loc. 38], (KTUB 2230); [Loc. 32], (KTUB 2237); [Loc. 23], (KTUB 2233); [Loc. 33], (KTUB 2227); [Loc. 41], (KTUB 2231); [Loc. 31], (KTUB 2245); [Loc. 37], (KTUB 2240); [Loc. 30], (KTUB 2232); [Loc. 40], (KTUB 2236); [Loc. 28], (KTUB 2238), on the thalli of *Candelariella vitellina*.

Carbonea supersparsa (Nyl.) Hertel – Iğdır: [Loc. 1], (KTUB 2234), on the thallus of *Lecanora polytropa*.

Carbonea vitellinaria (Nyl.) Hertel – Iğdır: [Loc. 11], (KTUB 2239); [Loc. 12], (KTUB 2241); [Loc. 13], (KTUB 2235); [Loc. 19], (KTUB 2243); [Loc. 38], (KTUB 2250); [Loc. 36], (KTUB 2242); [Loc. 39], (KTUB 2247); [Loc. 32], (KTUB 2246); [Loc. 22], (KTUB 2249); [Loc. 35], (KTUB 2248); [Loc. 30], (KTUB 2244), on the thalli of *Candelariella vitellina*.

Carbonea vorticosa (Flörke) Hertel – Iğdır: [Loc. 1], (KTUB 2254), on the thallus of *Lecidella* sp. Recorded for the second time in Turkey.

Cercidospora caudata Kernst. – Iğdır: [Loc. 36], (KTUB 2251), on the thallus and apothecia of *Caloplaca conversa*.

Cercidospora macrospora (Uloth) Hafellner & Nav.-Ros. – Iğdır: [Loc. 32], (KTUB 2253); [Loc. 33], (KTUB 2256); [Loc. 30], (KTUB 2252); [Loc. 7], (KTUB 2268); [Loc. 6], (KTUB 2259); [Loc. 34], (KTUB 2267), on the thalli and apothecia of *Lecanora muralis*.

Cercidospora melanophthalmae Nav.-Ros., Calat. & Hafellner – Iğdır: [Loc. 10], (KTUB 2261); [Loc. 38], (KTUB 2255), on the thalli and apothecia of *Rhizoplaca melanophthalma*. Second record for Turkey.

Cercidospora solearispora Calat., Nav.-Ros. & Hafellner – Iğdır: [Loc. 34], (KTUB 2260), on the thallus of *Aspicilia cinerea* and *Lecanora muralis*. This species is characterized by its caudate spores with strongly heteropolar septum, 20.0-26.0 × 6.0-6.5 µm, was previously reported for Turkey by Halici *et al.* (2007). Second record for Turkey.

Cercidospora xanthoriae (Wedd.) R. Sant. – Iğdır: [Loc. 29], (KTUB 2266); [Loc. 30], (KTUB 2263), on the thalli and apothecia of *Xanthoria elegans*. Asci mostly 4-spored; ascospores not heteropolar, pointed at the ends, 23.0-27.0 × 5.5-7.0 µm.

Dactylospora saxatilis (Schaer.) Hafellner – Iğdır: [Loc. 28], (KTUB 2269); [Loc. 27], (KTUB 2264); [Loc. 20], (KTUB 2270); [Loc. 35], (KTUB 2258), on the thalli of *Pertusaria flavicans*.

Echinothecium reticulatum Zopf – Iğdır: [Loc. 13], (KTUB 2271); [Loc. 2], (KTUB 2257), on the thalli of *Parmelia saxatilis*.

Endococcus macrosporus (Hepp ex Arnold) Nyl. – Iğdır: [Loc. 28], (KTUB 2265); [Loc. 31], (KTUB 2262), on the thalli of *Rhizocarpon geographicum*.

Endococcus rugulosus Nyl. – Iğdır: [Loc. 19], (KTUB 2276), on the thallus of *Buellia sequax*.

Endococcus stigma (Körb.) Stizenb. – Iğdır: [Loc. 13], (KTUB 2272), on the thallus of *Acarospora* sp.

Endohyalina insularis (Arnold) Giralt, Van den Boom & Elix – Iğdır: [Loc. 27], (KTUB 2274), on the thallus of *Lecanora rupicola*.

Gemmaspora lecanorae (Werner) D. Hawksw. & Halici – Iğdır: [Loc. 21], (KTUB 2275); [Loc. 8], (KTUB 2280), on the thalli of *Aspicilia* sp. This genus was first described by Werner (1964). *G. lecanorae* was reported for the first time on the thalli of *Aspicilia* cf. *farinosa* and *A. calcarea* for Turkey by Hawksworth & Halici (2007) and was found for the second time on *Aspicilia* sp. in this study.

Intralichen lichenicola (M. S. Christ. & D. Hawksw.) D. Hawksw. & M. S. Cole – Iğdır: [Loc. 20], (KTUB 2273), on the thallus and apothecia of *Candelariella vitellina*, [Loc. 36], (KTUB 2277), on the thallus of *Caloplaca conversa*.

Intralichen christiansenii (D. Hawksw.) D. Hawksw. & M.S. Cole – Iğdır: [Loc. 36], (KTUB 2279), on the thallus of *Caloplaca conversa*.

Lichenonium lecanorae (Jaap) D. Hawksw. – Iğdır: [Loc. 2], (KTUB 2278), on the thallus of *Rhizoplaca chrysoleuca*.

Lichenostigma dimelaenae Calat. & Hafellner – Iğdır: [Loc. 38], (KTUB 2284); [Loc. 8], (KTUB 2281); [Loc. 12], (KTUB 2285); [Loc. 39], (KTUB 2282); [Loc. 32], (KTUB 2290); [Loc. 29], (KTUB 2288); [Loc. 20], (KTUB 2286); [Loc. 25], (KTUB 2283); [Loc. 21], (KTUB 2289); [Loc. 5], (KTUB 2291), on the thalli of *Dimelaena oreina*.

Lichenostigma elongatum Nav.-Ros. & Hafellner – Iğdır: [Loc. 21], (KTUB 2297); [Loc. 15], (KTUB 2293); [Loc. 21], on the thalli of *Aspicilia caesiocinerea*; [Loc. 16], (KTUB 2287); [Loc. 2], (KTUB 2294); [Loc. 34], (KTUB 2292); [Loc. 32], (KTUB 2296); [Loc. 17], (KTUB 2295); [Loc. 18], (KTUB 2298); [Loc. 27], (KTUB 2300), on the thalli of *Aspicilia cinerea*.

Lichenostigma rugosum G. Thor – Iğdır: [Loc. 32], (KTUB 2310), on the thallus of *Diploschistes muscorum*.

Lichenostigma radicans Calat. & Barreno – Iğdır: [Loc. 32], (KTUB 2304), on the thallus of *Aspicilia* sp. This species was described in detail by Calatayud & Barreno (2003). Previously known from Spain and North America. New to Turkey. Ascomata blackish, scarce or 2-6 ascomata in group, mostly immersed in the host thallus, rounded, $\leq 70.0 \mu\text{m}$ tall, $\leq 165.0 \mu\text{m}$ wide; upper part mostly smooth; lower part usually penetrating downwards into the host thallus. Internal structure stromatic, paraplectenchymatous, $5.0\text{-}7.5 \mu\text{m}$ diam. Asci 8-spored, fissitunicate, subglobose, ca. $17.0\text{-}20.0\text{-}(2.0) \mu\text{m}$ high, $12.5\text{-}14.5 \mu\text{m}$ wide; ascospores brown, 1-septate, obovate, with rounded apices, constricted at the septum, oldest with a verruculose surface, $10.0\text{-}13.0\text{-}(14.0) \times 5.0\text{-}7.0\text{-}(7.5) \mu\text{m}$. Anamorph unknown.

Lichenostigma subradians Hafellner, Calat. & Nav.-Ros. – Iğdır: [Loc. 17], (KTUB 2302); [Loc. 24], (KTUB 2306), on the thalli of *Acarospora* sp. This species was described in detail by Calatayud *et al.* (2002). Previously known from the United States (state of Arizona), Saudi Arabia, the Canary Islands and Mexico. New to Turkey. Ascomata black, superficial, mostly elongated, each radiating a black strand of vegetative hyphae on the surface of the host, usually adpressed with a main axis showing a few short lateral branches; main strands composed of 2-4 rows of cells, lateral branches composed of 1-2 rows of cells. Additional vegetative hyphae penetrating into the host thallus, hyaline. Asci 8-spored, multiple, fissitunicate, subglobose or broadly obovate, $25.0\text{-}30.0 \times 18.0\text{-}25.0 \mu\text{m}$; ascospores 1-septate, ellipsoid or obovate, with rounded apices, slightly constricted at the septum, pale brown, with a granular surface when mature, $9.0\text{-}10.0\text{-}(11.0) \times (5.0\text{-})5.5\text{-}6.5 \mu\text{m}$. Anamorph unknown.

Lichenostigma triseptatum Halici & D. Hawksw. – Iğdır: [Loc. 1], (KTUB 2308), on the thallus of *Aspicilia caesiocinerea*.

Muellerella erratica (A. Massal.) Hafellner & V. John – Iğdır: [Loc. 31], (KTUB 2305), on the thallus of *Lecanora* sp.; [Loc. 27], (KTUB 2303); [Loc. 21], (KTUB 2307); [Loc. 10], (KTUB 2301); [Loc. 7], (KTUB 2299), on the thalli of *Aspicilia* spp.; [Loc. 3], (KTUB 2311), on the thallus of *Lecidea* sp.; [Loc. 28], (KTUB 2309); [Loc. 24], (KTUB 2315), on the thalli of *Acarospora* sp.; [Loc. 36], (KTUB 2312), on the thallus of *Lecidea* sp.

Muellerella pygmaea (Körb.) D. Hawksw. – Iğdır: [Loc. 29], (KTUB 2320); [Loc. 2], (KTUB 2314); [Loc. 34], (KTUB 2313); [Loc. 27], (KTUB 2318); [Loc. 21], (KTUB 2316); [Loc. 30], (KTUB 2319); [Loc. 28], (KTUB 2322), on the thalli of *Acarospora* sp.; [Loc. 10], (KTUB 2317), on the thallus of *Lecidea fuscoatra*. Ascus 32-spored, sometimes only 8-spored, little more brown, when young hyaline and simple, verruculose surface, $9.0\text{-}12.0 \times 5.5\text{-}7.0 \mu\text{m}$, much larger than normal.

Muellerella ventosicola (Mudd) D. Hawksw. – Iğdır: [Loc. 29], (KTUB 2329), on the thallus of *Rhizocarpon geographicum*.

Polycoccum evae Calat. & V.J. Rico – Iğdır: [Loc. 35], (KTUB 2328); [Loc. 11], (KTUB 2330); [Loc. 4], (KTUB 2324); [Loc. 2], (KTUB 2327); [Loc. 25], (KTUB 2325), on the thalli of *Dimelaena oreina*.

Sclerococcum sphaerale (Ach.) Fr. – Iğdır: [Loc. 6], (KTUB 2326), on the thallus of *Pertusaria* sp. This species was described in detail by Hawksworth & Jones (1981). Previously known from Austria, Czech Republic, Luxembourg, Spain and Portugal. New to Turkey. Sporodochia black, in spherical or hemispherical tufts, 170.0-350.0 µm, suppressing the formation of isidia on the host thallus of *Pertusaria* sp. Under microscopy, conidia thick and even walled, without fissures or thickened parts, thick-walled cells with dark walls. Mostly 6.0-10.0 µm in diameter.

Stigmatidium tabacinae (Arnold) Triebel – Iğdır: [Loc. 27], (KTUB 2355), on the thallus of *Toninia sedifolia*.

Tetramelas pulverulentus (Anzi) A. Nordin & Tibell – Iğdır: [Loc. 26], (KTUB 2323), on the thallus of *Physcia dubia*.

Zwackhiomyces cervinae Calat., Triebel & Pérez-Ortega – Iğdır: [Loc. 13], (KTUB 2333), on the thallus of *Acarospora* sp.

Zwackhiomyces coepulonus (Norman) Grube & R. Sant. – Iğdır: [Loc. 40], (KTUB 2321); [Loc. 14], (KTUB 2331), on the thalli of *Caloplaca lobulata*; [Loc. 18], (KTUB 2332); [Loc. 29], (KTUB 2334), in the apothecia of *Xanthoria elegans*. Conidiomata with conidiogenous cells, 10-15 × 1-1.5 µm and bacilliform conidia, 2.0-3.5 × 0.5 µm.

Discussion

All lichenicolous fungi were collected on foliose and crustose lichens. Only one species of lichenicolous fungi was found on the host genera *Buellia*, *Diploschistes*, *Lecidea*, *Lecidella*, *Parmelia*, *Phaeophyscia* and *Toninia*, whereas we found two species on *Pertusaria*, *Rhizocarpon* and *Rhizoplaca*; three species on *Caloplaca*, *Physcia*, *Candelariella vitellina*, *Dimelaena oreina* and *Xanthoria elegans*; five species on *Acarospora*; six species on *Lecanora* (*Lecanora* sp., *L. muralis*, *L. rupicola* and *L. polytropia*); and seven species on *Aspicilia*.

Arthonia molendoi, *A. protoparmeliopsidis*, *Cercidospora caudata*, *C. macrospora*, *C. melanophthalmae*, *C. xanthoriae*, *Intralichen lichenicola*, *Zwackhiomyces coepulonus* were found on the thallus and apothecia of foliose and crustose species; 27 other species were found only on the thallus of crustose lichenized fungi; and 4 species were found only on the thallus of foliose lichens.

The most common genera of lichenicolous fungi identified were *Lichenostigma*, *Cercidospora* and *Arthonia*, and the most common species were *Caloplaca grimmiae*, *Carbonea vitellinaria*, *Cercidospora macrospora*, *Lichenostigma dime-*

laenae, *L. elongatum*, *Muellerella erratica* and *M. pygmaea*. We found eight lichenicolous fungi at sites 21 and 32; seven species at site 30; and six species at sites 2, 20 and 29. The host preference of lichenicolous fungi, especially that of those representing new records, was found to be largely identical to that reported in the literature (Hawksworth 2003; Etayo & Sancho 2008; Halici 2008).

It is of note that all samples were found on the host thalli of 26 different crustose or foliose lichens, collected mostly from rocks. Although the Iğdır province is one of the poorest regions of Turkey, in terms of the amount of forest cover, and is dominated by steppe, the lichenicolous biodiversity was moderately rich. This might be attributable to the Mediterranean climate of the area.

All of the species of lichenicolous fungi listed here represent new records for the Iğdır region, and four (*Arthonia protoparmeliopsidis*, *Lichenostigma radicans*, *Lichenostigma subradicans* and *Sclerococcum sphaerale*) are new to Turkey. In addition, *A. protoparmeliopsidis* is new to Asia.

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