Some pyronemataceous macrofungi from Ladakh (J&K), India

Yangdol R, Kumar S and Sharma YP

Department of Botany, University of Jammu, Jammu 180 006, Jammu and Kashmir, India


Abstract

Six pyronemataceous macrofungi representing four genera (Anthracobia, Geopora, Geopyxis and Pulvinula) were collected from various locations of Leh district of Ladakh during 2012–2014. These include two species each of Geopora and Pulvinula (Geopora arenicola, G. sepulta, Pulvinula convexella and P. miltina) and one species each of Anthracobia and Geopyxis (Anthracobia macrocystis and Geopyxis majalis respectively). All these taxa are being reported for the first time from Ladakh. Also, Geopora sepulta and Geopyxis majalis constitute new records for India while as Anthracobia macrocystis, Pulvinula convexella and P. miltina are new additions to the macrofungal flora of Jammu and Kashmir.

Key words – Ascomycetes – Ladakh – New records – Pezizales – Taxonomy

Introduction

The Pyronemataceae is the largest family of the order Pezizales that includes 80 genera with approximately 662 species (Kirk et al. 2008). Members of the family are primarily temperate to arctic-alpine in distribution, with a few taxa known from the tropics. Varied ascomatal forms, with sessile to stipitate, cupulate, discoid, pulvinate, or turbinate epigeous apothecia, as well as sub-hypogeous to hypogeous with closed, folded, or solid tuber-like ascomata are the common features of the family (Perry et al. 2007). With respect to substrate preference, they show great diversity being humicolous, coprophilous, lignicolous and bryophilous. Besides, several genera have been found to be parasitic on bryophytes and an increasing number of species are being identified as ectomycorrhizal associates as well (Fujimura et al. 2005, Smith et al. 2006, Tedersoo et al. 2013).

While surveying the different localities of Leh district of Ladakh for the collection of ascomycetous macrofungi during the monsoon season, six species of the Pyronemataceae i.e Anthracobia macrocystis (Cooke) Snyder, Geopora arenicola (Lev.) Kers, G. sepulta (Fr.) Korf & Burds, Geopyxis majalis (Fr.) Sacc., Pulvinula convexella (P. Karst.) Pfister and P. miltina (Berk.) Rifai were recorded and taxonomically described along with field photographs, microphotographs and camera lucida drawings. All these taxa are being reported for the first time from Ladakh. Also, Geopora sepulta and Geopyxis majalis constitute new records for India while as Anthracobia macrocystis, Pulvinula convexella and P. miltina are new additions to the macrofungal flora of Jammu and Kashmir.
Materials & Methods

Ascocarps were collected from various locations of Leh district of Ladakh (32°15’–36°N latitude and 75°15’–80°15’E longitude with an altitude of 2300–5000 m above the sea level) during July–September, 2012–2014. Macroscopic features of the ascocarps and their habitat were noted in the field. Sony Cyber-shot 14.1 MP digital camera was used for field photography. Micro morphological characters were recorded from dried sample, after reviving in 3% KOH solution, and then staining with 1% aqueous Congo red. Line drawings of microscopic details were drawn with the aid of Camera lucida fitted on Olympus CH 20i binocular microscope and measurements were recorded for each character for description of average dimensions. For colour terminology, Ridgeway (1912) was followed. The studied specimens were deposited in the Herbarium of Botany Department, University of Jammu (HBJU) with accession numbers. Facesoffungi numbers are also provided (Jayasiri et al. 2015).

Results


Facesoffungi Number: FoF03309


**Ascocarp** 0.2–0.8 cm in wide, disc concave, reddish orange (I i 5. OO-R.), inconspicuous hairs surrounding the margin and readily collapsing when dried; **Asci** cylindrical, 220.0–288.0 µm in length, 12.0–16.0 µm wide at the top, 12.0–18.0 µm at the middle and 6.0–8.0 µm at the bottom, hyaline, thin walled, operculate, 8- spored, uniseriate, tapering towards the base, not blueing in iodine; **Ascospores** ellipsoidal, 23.2–26.4 × 10.4–12.8 µm, a, L= 24.8, a,W= 11.6, Q= 2.2–2.0, hyaline, thick walled, smooth, mono- to bi guttulate; **Paraphyses** filiform, 4.0–8.0 × 2.0–4.0 µm, hyaline, thin walled, septate, branched, bulbous at the apex; **Ectal excipulum** composed of globose to ellipsoid cells, 14.0–56.0 × 16.0–56.0 µm, hyaline, thick walled; **Medullary excipulum** composed of hyaline, thin walled, cylindrical to globose cells, 14.0–36.0 × 10.0–16.0 µm; **Marginal hairs** 4.0–8.0 µm in wide at the top, 6.0–10.25 µm at the middle, dark olive green, double walled, septate, pointed towards the tip.

Edibility – Not edible in the study area


Remarks – The above examined species corroborates well with the description given for *Anthracobia macrocystis* by Yao et al. (1998) from Britain.


Facesoffungi Number: FoF03771


**Ascocarp** 0.5–1.0 cm in diameter, 0.8 cm in height, spherical to depressed spherical, hollow with one single cavity, sessile, outer surface buff brown (XL i.17”O-Y.), minutely roughened, inner surface creamish to white; **Asci** cylindrical, 200.0–304.0 × 12.8–22.4 µm, hyaline, thick walled, operculate, 8- spored, uniseriate, tapering towards the base; **Ascospores** ellipsoidal to broadly ellipsoidal, 17.6–22.4 × 11.2–15.2 µm, avL= 20.0, avW = 13.2, Q = 1.6–1.5, hyaline, thick walled, smooth, monoguttulate; **Paraphyses** elongated, 6.0–8.0 µm wide at the top, 2.0–4.0 µm at the middle, hyaline, thin walled, septate, branched, bulbous at the tip; **Ectal excipulum** composed of oval to angular cells, 10.0–24.0 µm in wide, hyaline to brownish, thick walled; **Medullary
excipulum composed of hyaline, thick walled densely compacted cylindrical to sub globose cells, 10.0–32.0 × 6.0–18.0 µm.

Edibility – Not consumed in the study area but edibility reported some in other area (Kumar & Sharma 2009).


Remarks – The taxonomic details of above examined species is close to the details given for Geopora arenicola by Lars (1974) and Kumar & Sharma (2009) from Sweden and Jammu and Kashmir respectively.

Geopora sepulta (Fr.) Korf & Burds., in Burdsall, Mycologia 60(3): 500 1968. Figs 1c, 2C
Facesoffungi Number: FoF03296
Apothecia 0.9–1.7 cm in diameter, 0.7–1.7 cm in depth, subglobose, hypogeous in development and buried in soil at first, opening by a small pore then expanding somewhat and emerging at the ground surface, external surface buff brown, minutely roughened with flexuous, pale brown hairs, inner surface creamish to pure white, smooth; Asci cylindrical, 260.0–304.0 × 18.0–20.0 µm wide at the top, 16.0–24.0 µm at the middle and 12.0–14.0 µm at the base, hyaline (in Congo red), light brownish (in 3% KOH), thick walled, operculate, uniseriately arranged, 8-spored, tapering towards the base; Ascospores ellipsoid to broadly ellipsoidal, 21.6–25.6 × 14.4–17.6 µm, a,L = 23.6, a,W = 16.0, Q = 1.5–1.5, hyaline to watery colour, thick walled, smooth, monoguttulate; Paraphyses filiform, 2.0–4.0 µm wide, hyaline, septate, slightly bulbous at the tip; Ectal excipulum of globose to sub globose, 11.2–14.4 × 5.6–8.0 µm, hyaline, thin walled; Medullary excipulum of densely intertwined globose to elongated cells, 14.0–36.0 × 12.0–24.0 µm, hyaline to light brown, thin walled.

Edibility – Not eaten in the study area.


Distribution – The species has earlier been reported from Britain (Yao & Spooner 1996). It constitutes new fungal report from India.

Remarks – The presence of subglobose, externally pale brown to fawn apothecia with flexuous hairs and hypogeous development are typical features of Geopora sepulta. On comparing the macro- and microscopic details, the above examined specimen is found close to the description given for Geopora sepulta by Yao & Spooner 1996a.

Geopyxis majalis (Fr.) Sacc., Syll. fung. 8: 72 (1889) Figs 1d, 2D
Facesoffungi Number: FoF03295
Apothecia cup to saucer shaped, 0.2–0.3 cm in diameter, upto 0.5 cm in depth, deep chrome (III b 17. O-Y.), margin whitish and crenate; Asci cylindrical, 180.0–232.0 × 12.0–20.0 µm, hyaline, thin walled, inoperculate, each ascus contain eight ascospores, uni-to biseriately arranged in an ascus, tapering towards the base; Ascospores ellipsoid to broadly ellipsoidal, 17.6–22.4 × 9.6–12.8 µm, a,L = 20.0, a,W = 11.2, Q = 1.8–1.8, hyaline, thick walled, mono- to biguttulate; Paraphyses filiform, 4.0–5.6 µm at the top, 2.0–4.0 µm at the middle, hyaline, septic, thin walled, enlarged at the tip; Ectal excipulum composed of light brownish, globose to angular, narrow diameter cells; Medullary excipulum of hyaline, septic hyphae, 4.0–10.0 µm wide.

Edibility – Not edible in the study area.

Distribution – Earlier reported to grow on sandy soil from south eastern Lithuania and Turkey (Kutorga 2002, Kaya et al. 2016). A new report for India.

Remarks – The diagnostic characters of the Ladakh collection are in agreement to those given for Geopyxis majalis by Kaya et al. 2016. from Turkey.


Facesoffungi Number: FoF03323


*Barlaea convexella* (P. Karst.) Sacc., *Syll. fung.* (Abellini) 8: 114 1889.

_Apothecia_ 1.0–1.5 cm in diameter, disc concave to flat, yellowish orange (III b 15. Y-O.), smooth, sessile; _Asci_ cylindrical, 228.0–280.0 µm in long, 10.0–18.0 µm wide at the top, 12.0–18.0 µm at the middle and 6.0–14.0 µm at the bottom, hyaline, thick walled, ascospores 8, sometimes fewer per ascus, uniseriately arranged, narrower towards the base; _Ascospores_ globose to subglobose, 9.6–19.2 × 9.6–16.0 µm, a,L= 14.4, a,W= 12.8, Q= 1.0–1.2, hyaline, thick walled, smooth, mono- to multiguttulate.; _Paraphyses_ filiform, 2.0–6.0 µm in wide, hyaline, thin walled, septate, multiguttulate, moderately curved at the apex; _Pubescent hairs_ 6.0–14.0 µm wide, hyaline, septate; _Ectal excipulum_ of globose to subglobose cells, 8.0–10.0 × 10.0–16.0 µm, hyaline, thin walled; _Medullary excipulum_ composed of 2.0–4.0 µm wide septate hyphae, hyaline, thin walled.

Edibility – Not edible in the study area.


Remarks – The macro-micro morphological details of the examined species are in line with the description mentioned for *Pulvinula convexella* by Pfister 1976.


Facesoffungi Number: FoF03316


*Barlaea miltina* (Berk.) Sacc., *Syll. fung.* (Abellini) 8: 113 1889.


_Apothecia_ 0.3–0.7 cm in diameter, sessile, disc concave to flat, smooth, capucine yellow (III b 15. Y-O.); _Asci_ cylindrical, 220.0–240.0 × 14.0–18.0 µm wide at the top, 14.0–16.0 µm at the middle and 10.0–14.0 µm at the base, hyaline, thin walled, ooperculate, eight ascospores per ascus, uniseriately arranged, tapering towards the base; _Ascospores_ globose to subglobose, 10.4–15.2 × 10.4–13.6 µm, a,L= 12.8, a,W = 12.0, Q = 1.0–1.1, hyaline, thick walled, smooth, monoguttulate; _Paraphyses_ elongated, 1.6–2.4 µm in wide, hyaline, thin walled, septate, unbranched, curved at the apex; _Pubescent hairs_ inconspicuous; _Ectal excipulum_ of hyaline, globose to subglobose cells, 6.0–10.0 × 8.0–14.0 µm; _Medullary excipulum_ consisting of inconspicuous, narrow diameter hyphae, hyaline, thin walled.

Edibility – Not edible in the study area.


Distribution – The species has earlier been reported on soil among mosses in Ranikhet and Dhakuri on the way of Pindhari (Uttarakhand) (Pant & Das 1992). This constitutes a new report to Jammu and Kashmir.
Remarks – The macro- and microscopic description of the Ladakh collection is in agreement with the details given by Yao & Spooner 1996b.

Fig. 1 – Ascocarps in natural habitat: a. Anthracobia macrocystis b. Geopora arenicola c. G. sepulta d. Geopyxis majalis e. dense group of Pulvinula convexella f. P. miltina

Discussion

Interestingly, the occurrence of pyronematous members in this unique ecosystem of Leh district of Ladakh, which is quite hostile for the growth of organisms because of extreme dryness, barrenness, low humidity and low annual precipitation, indicates the presence of some stress emulators in these macrofungi. During the present investigation, it was realized that ascospores were thick walled and guttulated. (Mundkur 1959) observed that guttulation i.e. oil droplets,
remain unfrozen even at sub-zero temperature and also serve as reserve food whereas thickened walls of the ascospores might protect the inner contents from desiccation.

Fig. 2 – A: *Anthracobia macrocystis*: a. asci b. ascospores c. paraphyses d. marginal hairs e. ectal excipulum
B: *Geopora arenicola*: a. asci b. ascospores c. paraphyses d. ectal excipulum
C: *G. sepulta*: a. asci b. ascospores c. paraphyses d. ectal excipulum
D: *Geopyxis majalis*: a. asci b. ascospores c. paraphyses
E: *Pulvinula convexella*: a. asci b. ascospores c. paraphyses d. pubescent hairs
F: *P. miltina*: a. asci b. ascospores c. paraphyses
Acknowledgements

Thanks to the Head, Department of Botany (UGC-SAP DRS), University of Jammu, Jammu for providing laboratory facilities. The first author also wishes to acknowledge the financial assistance received from UGC (RGNF-ST) in the form of senior research fellow.

References


Kaul TN. 1971 – Mushroom research at Regional Research Laboratory, Jammu. 2nd International Symposium on Plant Pathology, New Delhi, 136 p.


