

A NEW LICHENICOLOUS FUNGUS FROM GARHWAL HIMALAYAN REGION OF UTTARAKHAND, INDIA

A. FALSWAL and B. S. BHANDARI

Ecology Laboratory, Department of Botany and Microbiology, HNB Garhwal University,
Srinagar Garhwal, 246174, Uttarakhand, India

E-mails: rtfalswal@gmail.com (corresponding author), bhandaribs11@gmail.com

(Received: 8 December 2020; Accepted: 10 August 2021)

Sphinctrina pertusa Falswal A. is described as a new species of lichenicolous fungus from India. It is characterised by eight non-septate, broadly ellipsoidal, uniseriate, ascospores with olive green tint and irregular ridge like ornamentations. This fungus is growing on known lichen host *Pertusaria* but differs from five closely related species i.e., *S. anglica*, *S. leucopoda*, *S. tubaeformis*, *S. turbinata*, *S. paramerae* with different taxonomic characters. A detailed comparative analysis with non-septate closely related species is provided.

Key words: Ascomycetes, lichens, *Pertusaria*, *Sphinctrina pertusa*, taxonomy

INTRODUCTION

Originally the genus *Sphinctrina* was described by E. Fries (Fries 1825), as a lichen parasite but not as a lichen in the absence of photobiont partner and based on its particular type of apothecia. After several years of studies, its position is now confirmed in the order Mycocaliciales Tibell et Wedin in the family Sphinctrinaceae Choisy including also *Pyrgidium* (Prieto and Wedin 2017, Tibell and Vinuesa 2005, Tibell and Wedin 2000, Wedin and Tibell 1997). The genus *Sphinctrina* is characterised by lacking or poorly developed thallus, sessile or stalked apothecia with capitulum, formation of well-developed mazaedium, asci with uniseriate 8-spore, septate or non-septate spore (sometimes with ornamentation) and their commensalistic interaction with its host lichen thalli.

Sphinctrina species are lichenicolous and prefer colonising on lichen thalli of *Pertusaria*, *Protoparmelia* and *Lecanora* in parasitic or in commensalistic form. To date, a total of ten species of *Sphinctrina* have been reported (Diederich *et al.* 2018, Lawrey and Diederich 2003). These ten species can be categorised into two groups, i.e., species with aseptate spores and species with septate spores. The first group includes *S. anglica* Nyl., *S. intermedia* Tibell, *S. leucopoda* Nyl., *S. paramerae* D. Muñiz et Hladun, *S. tubaeformis* A. Massal. and *S. turbinata* Fr.. The second group includes *S. benmargana* Selva, *S. ophioparmae* Kalb, *S. pallidella* (Willey) Selva and *S. porrectula* Nyl.. As far as India is con-

cerned, only three species are reported from different regions of the country as new records (*S. anglica*, *S. leucopoda*, *S. tubaeformis*) (Joshi 2008, Joshi *et al.* 2016, 2018). *Sphinctrina pertusa* is commensalistic in nature on *Pertusaria* as the most common host. Ascus size, ascospore size and ornamentation are the main features of this genus distinguishing its species.

MATERIAL AND METHODS

Fresh material has been collected from Dhotidhar on the way to Chopta, Chamoli district of Uttarakhand, India with the help of hammer and chisel from tree bark without damaging any living tissue of the host tree, dried at room temperature and kept in paper envelopes. Morphological study was carried under Olympus SZ40 stereo zoom microscope, thin sections from fruiting body were made manually with the help of stainless-steel blades and mounted in distilled water, and all measurements were taken in water mount. Sections were treated with 10% KOH solution and Lugol's solution without or with KOH pre-treatment under Olympus CX21i-LED microscope.

Measurements of apothecia height, ascus length-width and ascospore length-width were recorded. Identification of host lichens and lichenicolous fungi was done with the help of available literature (Awasthi 1991, Hawksworth 2003, Smith *et al.* 2009, Löfgren and Tibell 1979). Ascospore measurement (all measurements in water) is given as (minimum) $X \pm SD$ (maximum), Q, (n), where X = mean value and SD = standard deviation, Q = length/width ratio. 'n' denotes the total number of measurements.

TAXONOMY

Sphinctrina pertusa Falswal A., *spec. nova*
(Fig. 1)

Mycobank no.: MB 835778

Diagnosis: *Ascus and ascospore larger size as compared to other nine known species, spores brown but with green tint, irregular ridges like ornamentation, thick spore coat on immature spore gradually shrinking as spore matures. KOH treatment results in dissolvment of tissues, releases brown pigment in adjacent area. Closely related to Sphinctrina tubaeformis, but can be distinguished by the presence of short stalk (which is lacking in S. tubaeformis), by the weakly sclerotised exciple (which is sclerotised in S. tubaeformis), and by the thick ascospore coat (which is thin and indistinct in S. tubaeformis). Comparison between closely related species of Sphinctrina is provided in Table 1 (see Löfgren and Tibell 1979, Muñiz *et al.* 2013, Smith *et al.* 2009).*

Table 1
Comparison between closely related species of *Sphinctrina* with new taxon

Characters	<i>S. anglica</i>	<i>S. leucopoda</i>	<i>S. tubaeformis</i>	<i>S. turbinata</i>	<i>S. panamericae</i>	<i>S. pertusa</i>
Apothecium height (mm)	0.27–0.37	0.3–0.5	0.15–0.36	0.16–0.33	0.21–0.42	0.16–0.18
Stalk structure	dark to medium brown, hyphae with gelatinous coat	paler than excipulum hyphae with gelatinous coat	sessile or immersed in host epihymenium	sessile or short stalk	sessile	short and brown
Capitulum height	0.14–0.21 mm	0.12–0.19 μ m	0.14–0.25 (0.36) mm	0.16–0.36 mm	0.32–0.36 mm	0.23–0.27 μ m
Excipulum colour	–	–	dark brown	reddish brown to ruby red	reddish brown to pale brown	medium to dark brown
Hypotheecium colour	medium to pale brown	hyaline, 25–36 μ m	hyaline	30–35 μ m	medium to pale brown	brown, 33–39.6 μ m
Ascus size (μ m)	49–57 \times 7–8	32–45 \times 4.5–6	56–78 \times 6.8–9.2	40–51 \times 5–7	63.4–74.2 \times 8.1–9.5	(79.2) 82.4 \pm 7.3(85.8) \times (9.5) 10.0 \pm 0.7(10.5)
Ascospore shape	sub-spherical	sub-globose	ellipsoidal with pointed ends	globose to cuboid	ovoid shaped	sub-globose
Ascospore size (μ m)	8.3–10.1 \times 7.8–8.9	4.5–6 \times 4–6	12–15.5 \times 6–8	3.4–6.9 \times 4.5–7	8.9–11.7 \times 7.8–9.3	11.2–17.5 \times 3.6–4
Ascospore coat	thin	thick, distinct in water	thin, indistinct in water	thick and distinct	very thin	thick, gradually shrinks when ascospores mature
Chemical reaction	K–	K–	K–	K+ red	K+	K+
Ornamentation	dotted	absent or minute folds	longitudinal interconnected ridges	distinct minute pore, black pigmentation	indistinct under light microscope slightly rugose	long irregular branched ridges
Lichen host	<i>Protoparmelia</i> sp.	<i>Pertusaria</i> sp.	<i>Pertusaria leucopoda</i>	<i>Pertusaria</i> sp.	<i>Pertusaria panamericae</i>	<i>Pertusaria</i> sp.
Known distribution	North America, India	India	Europe, Japan, Africa, Central America, India	Southern California	Spain	Uttarakhand, India

Type: INDIA, Uttarakhand, Chamoli district, Dhotidhar area, 30° 27' 57" N, 79° 13' 12" E, alt. 2,650 m, on *Pertusaria* sp. lichen colonising on *Quercus semecarpifolia* bark, coll.: Arti Falswal and B. S. Bhandari, 19 October 2019 (holotype: AF0087).

Description: Thallus absent, apothecia black, short stalked (Fig. 1A–B), stalk with interwoven hyphae, margin not strongly curved, capitulum larger as compared to stalk height, black, smooth, shining, height 0.3–0.4 mm, with a colourless rim around exciple, mazaedium black and well developed. Excipulum brown in section and sclerotised, thick walled cell lining excipulum that continue down to the stalk, (Fig. 1C). Hypothecium pale brown, 33–39.6 μm . Asci cylindrical, eight spored, uniseriate, thin walled, without pigmentation, apical dome not seen under light microscope, $(79.2\text{--}82.4 \pm 7.3\text{--}85.8) \times (9.5\text{--}10.0 \pm 0.7\text{--}10.5) \mu\text{m}$ ($n = 30$). Ascospore broadly ellipsoidal to ovoid, brown with greenish tint, non-septate, $(9.9\text{--}11.2 \pm 2.7\text{--}17.5) \times (2.5\text{--}3.6 \pm 0.6\text{--}4) \mu\text{m}$; semimature ascospore envelop in ascus of cuboid shape, thick coat varies in

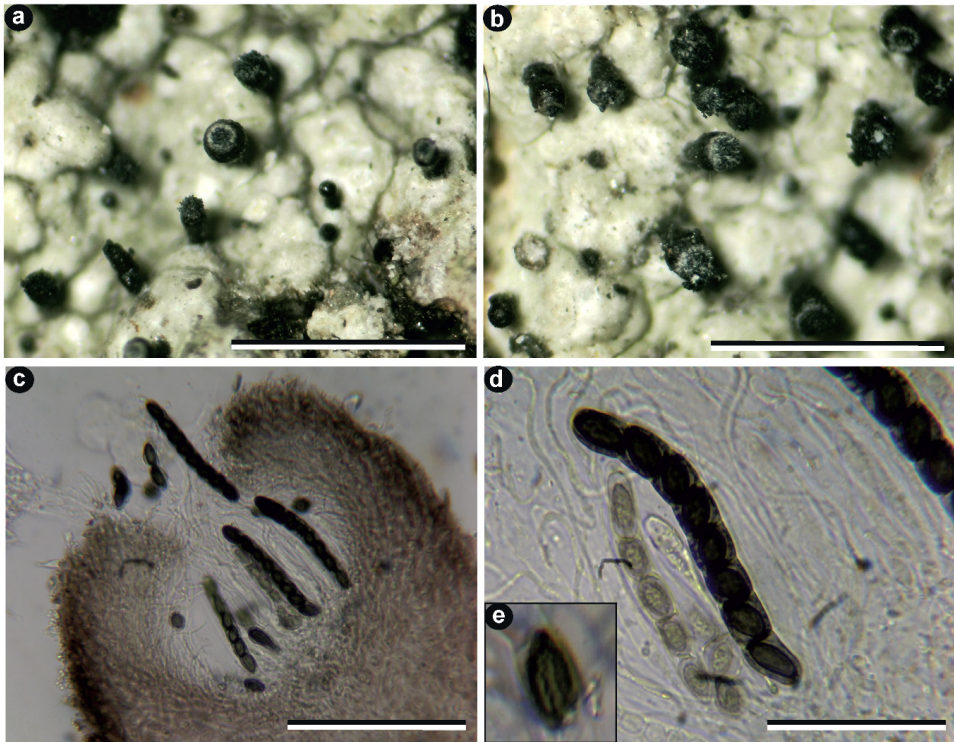


Fig. 1. *Sphinctrina pertusa* Falswal A., *spec. nova*. a–b = habit on lichen host (scale bar 1 mm); c = thin section of ascogonium showing exciple (scale bar 50 μm); d = ascus with 8 uniseriate spores (scale bar 25 μm); e = enlarged view of an ascospore showing irregular ridges (scale bar 25 μm)

thickness as ascospore matures, distal and proximal ascospore is larger and with pointed ends (Fig. 1D), ornamentation as irregular longitudinally arranged ridges are seen under light microscope. I-, K+ dissolves and releases brown colour in adjacent area, C-. Paraphysis hyaline, branched, septate. Pycnidia not seen.

Host lichen: On the thallus of *Pertusaria* sp. colonising on *Quercus semecarpifolia* tree bark.

Etymology: Fungus named after the host lichen genus *Pertusaria* on which it grows.

Distribution: The only known locality for this fungus up to now is India, Uttarakhand, Chamoli district, where it is growing on *Pertusaria* sp., colonising on tree bark. No visible damage was observed, therefore it is considered to live commensalistic relationship with its host.

*

Acknowledgements – Authors are highly thankful to the Head, Department of Botany and Microbiology for providing necessary laboratory facilities. Financial assistance to the first author by the University Grant Commission (UGC), New Delhi, as PhD fellowship is sincerely acknowledged.

REFERENCES

- Awasthi, D. D. (1991): A key to the microlichens of India, Nepal and Sri Lanka. – *Bibl. Lichenol.* **40**: 1–340.
- Diederich, P., Lawrey, J. D. and Ertz, D. (2018): The 2018 classification and checklist of lichenicolous fungi, with 2000 non-lichenized, obligately lichenicolous taxa. – *Bryologist* **121**: 340–425. <https://doi.org/10.1639/0007-2745-121.3.340>
- Fries, E. (1825): *Systema Orbis Vegetabilis. Primas lineas novae constrictiois periclitatur Elias Fries. Pars I. Plantae homonemae.* – Typog. Acad., Lundae, 374 pp.
- Hawksworth, D. L. (2003): The lichenicolous fungi of Great Britain and Ireland: an overview and annotated checklist. – *Lichenologist* **35**: 191–232. [https://doi.org/10.1016/S0024-2829\(03\)00027-6](https://doi.org/10.1016/S0024-2829(03)00027-6)
- Joshi, Y. (2018): Documentation of lichenicolous fungi from India. Some additional reports. – *Kavaka* **51**: 30–34.
- Joshi, Y., Falswal, A., Tripathi, M., Upadhyay, S., Bisht, A., Chandra, K., Bajpai, R. and Upreti, D. K. (2016): One hundred and five species of lichenicolous biota from India: an update checklist for the country. – *Mycosphere* **7**(3): 268–294. <https://doi.org/10.5943/mycosphere/7/3/3>
- Joshi, Y., Tripathi, M., Bisht, K., Upadhyay, S., Kumar, V., Pal, N., Gaira, A., Pant, S., Rawat, K. S., Bisht, S., Bajpai, R. and Halda, J. P. (2018): Further contribution to the documentation of lichenicolous fungi from India. – *Kavaka* **50**: 26–33.
- Lawrey, J. D. and Diederich, P. (2003): Lichenicolous fungi: interaction, evolution, and biodiversity. – *Bryologist* **106**: 80–120. [https://doi.org/10.1639/0007-2745\(2003\)106\[0080:Ifieab\]2.0.co;2](https://doi.org/10.1639/0007-2745(2003)106[0080:Ifieab]2.0.co;2)

- Löfgren, O. and Tibell, L. (1979): Sphinctrina in Europe. – *Lichenologist* **11**(2): 109–137. <https://doi.org/10.1017/s0024282979000189>
- Muñiz, D., Llop, E. and Hladun, N. L. (2013): Sphinctrina paramerae, a new Mediterranean lichenicolous species with non-septate spores. – *Lichenologist* **45**(2): 137–143. <https://doi.org/10.1017/s0024282912000801>
- Prieto, M. and Wedin, M. (2017): Phylogeny, taxonomy and diversification events in the Caliciaceae. – *Fungal diversity* **82**: 221–238. <https://doi.org/10.1007/s13225-016-0372-y>
- Smith, C. W., Aptroot, A., Coppins, B. J., Fletcher, A., Gilbert, O. L., James, P. W. and Wolseley, P. A. (eds): *The lichens of Great Britain and Ireland*. – British Lichen Society, London, 1046 pp.
- Tibell, L. and Vinuesa, M. (2005): Chaenothecopsis in a molecular phylogeny based on nuclear rDNA ITS and LSU sequences. – *Taxon* **54**(2): 427–442. <https://doi.org/10.2307/25065370>
- Tibell, L. and Wedin, M. (2000): Mycocaliciales, a new order for non-lichenized calicioid fungi. – *Mycologia* **92**(3): 577–581. <https://doi.org/10.2307/3761518>
- Wedin, M. and Tibell, L. (1997): Phylogeny and evolution of Caliciaceae, Mycocaliciaceae, and Sphinctrinaceae (Ascomycota), with notes on the evolution of the prototunicate ascus. – *Canad. J. Bot.* **75**: 1236–1242. <https://doi.org/10.1139/b97-837>