

Diversity of *Passalora* on *Ficus*

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Received: 28 August 2012 / Revised: 13 October 2012 / Accepted: 23 October 2012 / Published online: 28 November 2012
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Abstract During a survey of hyphomycetes, *Passalora trichophila* sp. nov. was discovered on living leaves of *Ficus mysorensis* (*Moraceae*) in a subtropical forest of eastern Uttar Pradesh, India. This species is described, illustrated and compared with morphologically similar species. A key to species of *Passalora* found on *Ficus* is provided. Descriptions and nomenclatural details were deposited in MycoBank (www.MycoBank.org).

Keywords Biodiversity · Foliar diseases · Hyphomycetes · Anamorphic fungi · Taxonomy

Introduction

The Indian subcontinent is well known as an area with enormous biodiversity, including a very wide range of vascular plants which are the base for a huge variety of foliicolous fungi. Cercosporoid hyphomycetes are among the most important components of the latter fungal group. They have a worldwide distribution, with special focus in tropical and subtropical areas. *Cercospora* Fresen. and allied genera of India are relatively well documented, and data on host range and distribution of Indian cercosporoid hyphomycetes have recently been summarized by Kamal (2010). Nevertheless, the inventory of species of this fungal group in India is far from being complete. During

the course of explorations of foliicolous micromycetes in a subtropical forest of eastern Uttar Pradesh (Sohagi Barwa Wildlife Sanctuary, Mahrajganj) in India, a hitherto unknown cercosporoid hyphomycete was found on living leaves of *Ficus mysorensis*. Detailed morphological examinations showed that this fungus represents an undescribed new species. Because of the formation of superficial hyphae with pigmented conidiophores formed single, thickened and darkened conidiogenous loci and pigmented conidia, the new species proved to be a member of the former genus *Mycovellosiella* (Muntañola 1960, Deighton 1974), which is nowadays considered a synonym of *Passalora* emend. Detailed discussions on nomenclature, phylogeny, synonymy and taxonomy of *Passalora* have been published by Braun (1995), Crous et al. (2000, 2001a, b), Crous and Braun (2003), Kamal (2010) and in various other books and papers. An updated key to cercosporoid genera has recently been published by Braun in Seifert et al. (2011). With regard to the generic concept applied in the case of the new species on *Ficus*, we follow the new circumscriptions outlined in the cited works and assign it to *Passalora*.

Materials and methods

Specimens with disease symptoms of cercosporoid fungi on living leaves were collected during the course of field trips. Photographs of infection spots on leaves were taken with a Sony DSC-5730 camera. Specimens for microscopic observation were prepared by hand sectioning. Morphological descriptions are based on slide preparations mounted in clear glycerin from infected areas of leaves. Observations were made with an Olympus BX-51 light microscope using a Syntek USB camera and LEO-430 scanning electron microscope. SEM micrographs were prepared at Birbal Sahni Institute of Palaeobotany, Lucknow, India. The specimens were coated with a thin layer of gold-palladium using a POLARON Sputter coater (180 s in nitrogen atmosphere of 20 mA, 30 mm distant from the electrode) and examined with a LEO-430 scanning electron

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microscope. Detailed observations of morphological characters and line drawings were carried out at different magnifications through light microscopy (300× and 1,000×) and scanning electron microscopy (500×, 2,000×, 4,000× and 5,000×). Measurements were made of 25 conidia, hila, and conidiophores and of 10 external stromata, with the extremes given in parentheses. Drawings of three other *Passalora* species reported by different authors on *Ficus* are provided which is based on original publications (Braun 1995, Crous and Braun 2003, Crous et al. 1998) for direct comparison with novel species. The holotype is deposited in Ajrekar Mycological Herbarium (AMH), Agharkar Research Institute, Pune, India, and an isotype is retained in the herbarium of the Department of Botany, D.D.U. Gorakhpur University (GPU) for further reference.

Results

Taxonomic description

Passalora trichophila R. Singh, S. Kumar, D. Saini, P. Upadhyaya, Kamal & U. Braun, sp. nov. (Figs. 1, 2, 3, and 4)

Mycobank No: MB 800961

Differt ab omnibus speciebus Passalorae ad species Fici (*P. bolleana*, *P. ficina*, *P. urostigmatis*) stromatibus et hyphis superficialibus cum conidiophoris solitariis.

Infection spots hypogenous, dark brown to black, discrete and at first limited to midribs and lateral veins, latter spreading over the lamina and coalescing, finally irregular and more or less necrotic (Fig. 1b, c). Colonies hypophyllous, effuse, brown to black, velvety, mostly along the midrib and veins. Mycelium superficial, hyphae branched, septate, thick-walled, dark brown, forming rope-like structures ascending leaf hairs, 1.5–3.5 μm wide. Stromata external, only on trichomes (Figs. 2e–h and 4b), compact stroma on top of trichomes (Figs. 2b–d and 3a), pseudoparenchymatous, initially small, 3–13(25)×(3)3.5–10(14) μm, later 32–80(130)×30–60(127) μm. Conidiophores macronematous, born terminally and as lateral branches from superficial hyphae (Figs. 2i and 4e) or in loose fascicles of 2–14 arising from poorly developed external stromata on trichomes (Figs. 2f–h and 4b), later forming crown-like aggregations at the top of trichomes arising from well-developed external stromata (Figs. 2b–d, 3a and 4a, c, d),



Fig. 1 *Passalora trichophila* (AMH 9476, holotype) causing symptoms on leaf. **a** *Ficus mysorensis*. **b** Early symptoms on the lower side of the leaf. **c** Late symptoms on the lower side of the leaf. Scale bar **b**, **c** 15 mm

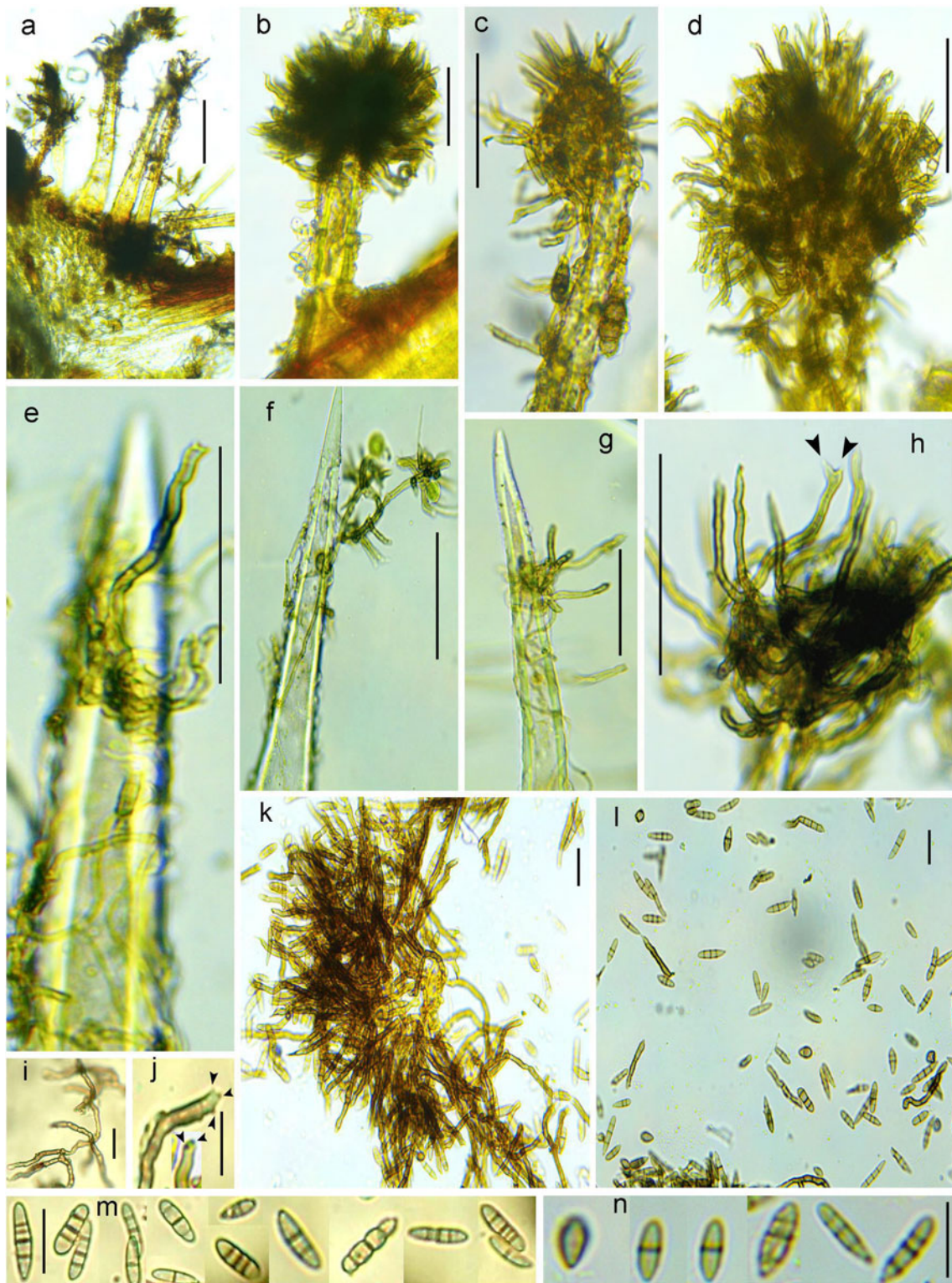


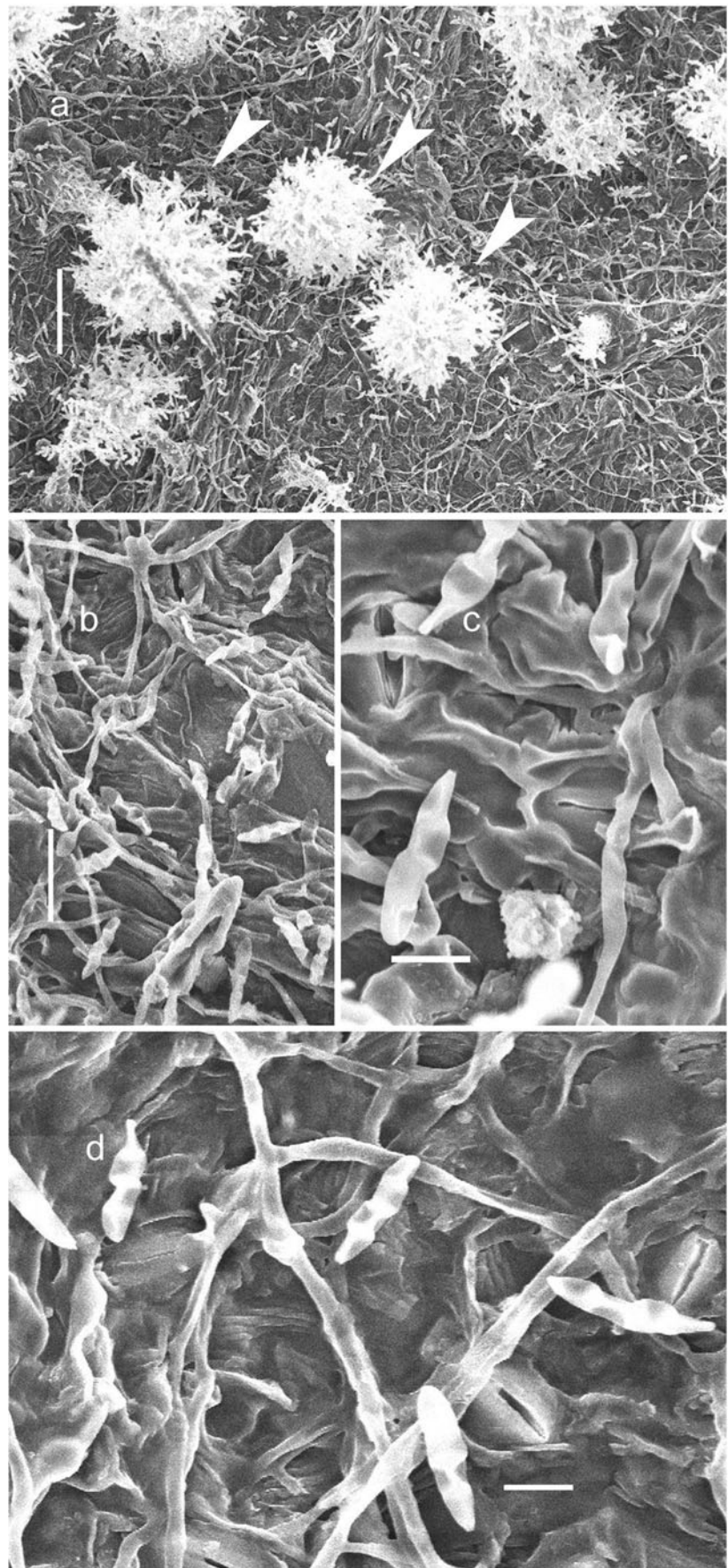
Fig. 2 *Passalora trichophila*, microscopic characteristics (AMH 9476, holotype). **a** Heavy infection on leaf trichomes. **b–d** Crown of conidiophores on compact stromata at the top of trichomes in late stage. **e–h** Loose stromata with conidiophores on trichomes in early

stage. **i** Superficial hyphae. **j** Conidiogenous cells with thickened and darkened–refractive scars (*black arrows* for polyblastic nature). **k** Intertwining conidiophores. **l–n** Conidia. *Scale bars a* 100 μm , **b–h** 50 μm , **i** 20 μm , **j** 10 μm , **k–n** 20 μm

unbranched to branched, very variable in length, 4–20(60) \times (1.5)2–3.5(5) μm , simple, erect to procumbent, straight to

flexuous, geniculate, wall smooth, thick, 0–5-septate, intertwining, light to mid brown. Conidiogenous cells integrated,

Fig. 3 *Passalora trichophila*, SEM characteristics (AMH 9476, holotype). **a** Heavy infection on leaf trichomes showing crowns of conidiophores (white arrows). **b–d** Superficial hyphae with fallen conidia at different magnification. Scale bars **a** 60 μm , **b** 20 μm , **c**, **d** 6 μm



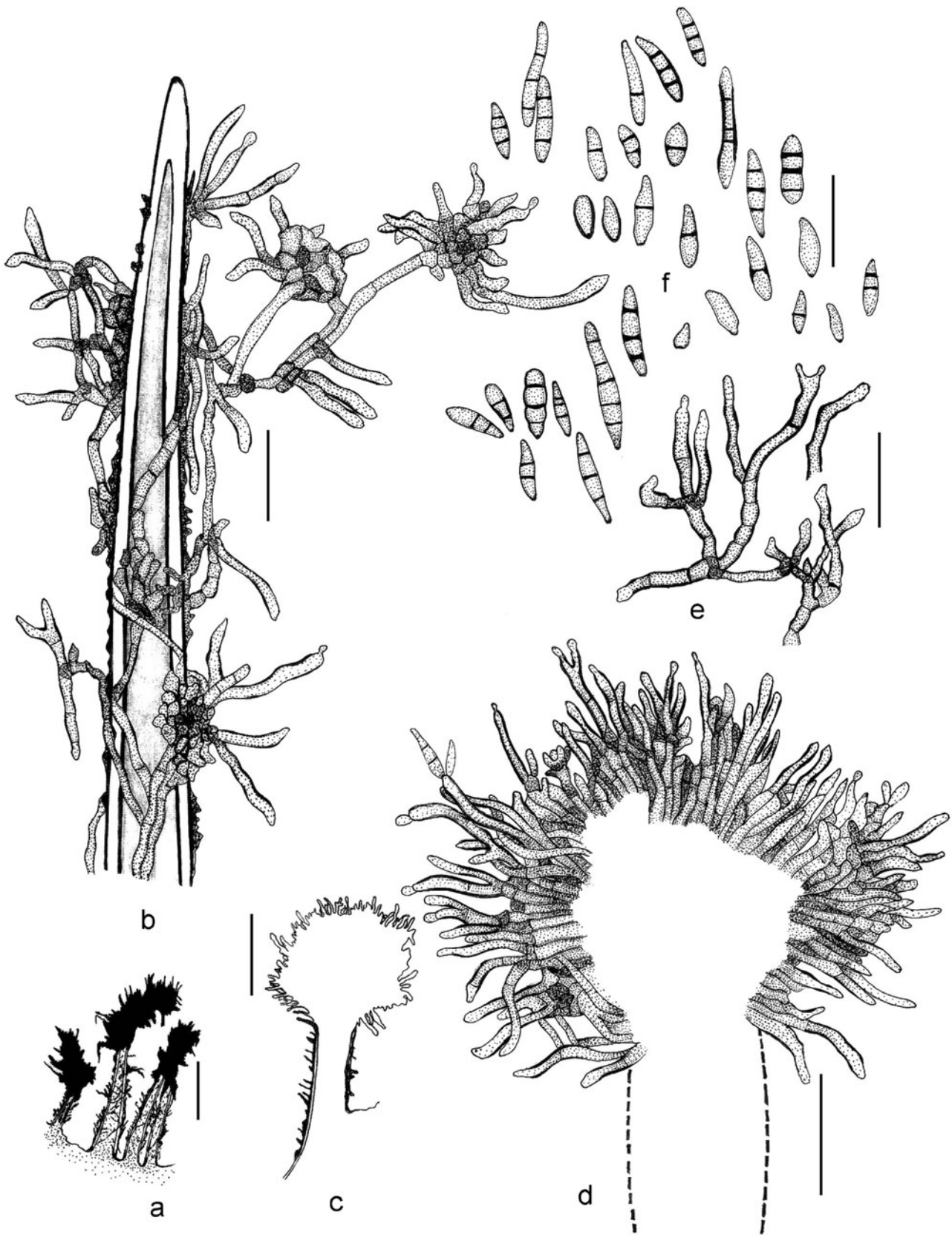


Fig. 4 Drawings of *Passalora trichophila* (AMH 9476, holotype). **a** Heavy infection on leaf trichomes. **b** Loose stromata with conidiophores at trichomes in early stage. **c–d** Crown of conidiophores on

compact stromata at the top of trichomes in late stage. **e** Hyphae with branched conidiophores. **f** Conidia. Scale bars **a** 100 µm, **b** 20 µm, **c** 100 µm, **d** 50 µm, **e**, **f** 20 µm

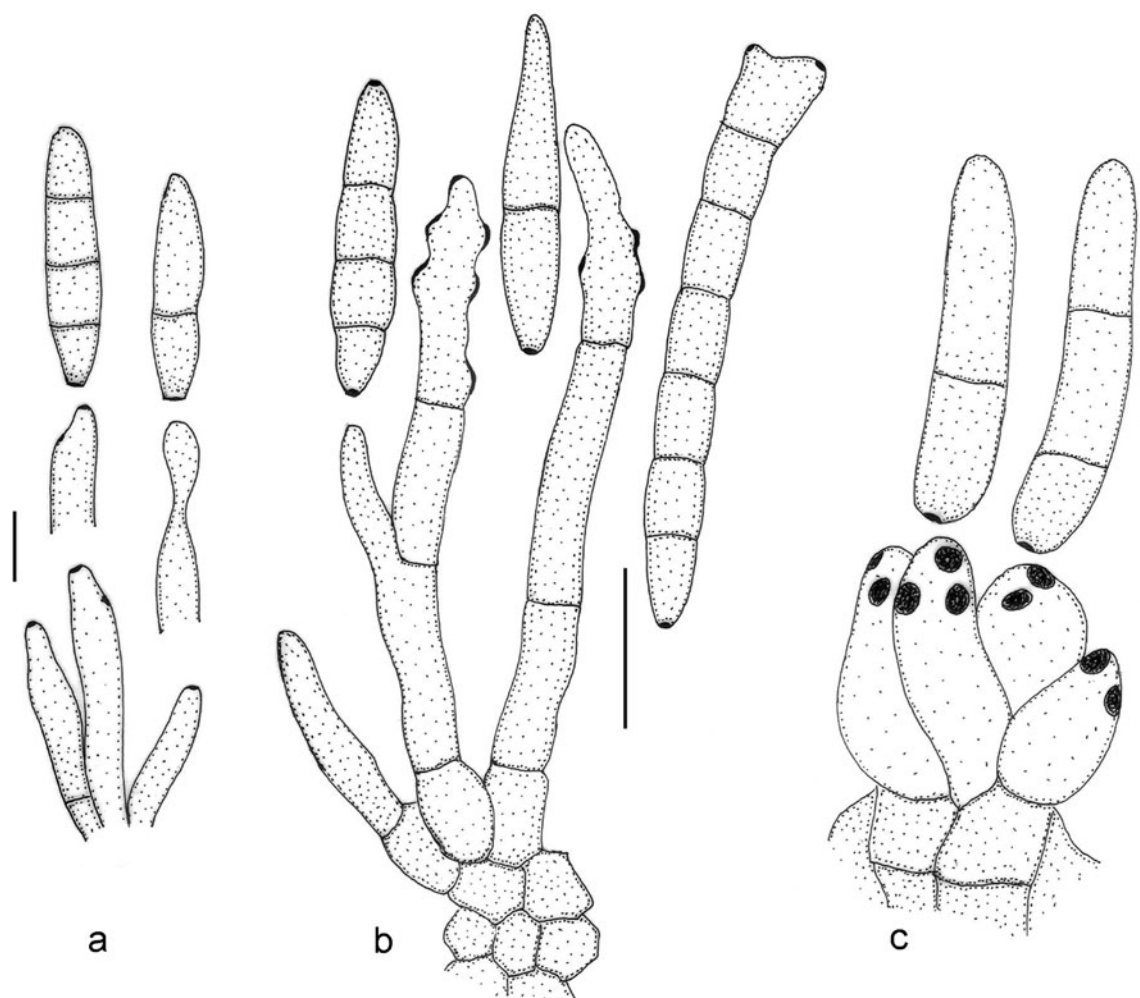


Fig. 5 Drawings of conidiophores and conidia of *Passalora* species on *Ficus* spp. other than *P. trichophila* **a** *Passalora bolleana* (Braun 1995). **b** *Passalora ficina* (Crous and Braun 2003). **c** *Passalora urostigmatis* (Crous et al. 1998). Scale bars 10 μ m

terminal and lateral, monoblastic to polyblastic (Figs. 2h, j), cylindrical to clavate, cicatrized, scars somewhat thickened and darkened-refractive. Conidia acropleurogenous, solitary, straight to slightly curved, cylindrical, narrowly ellipsoidal, fusiform or obclavate to oval, unbranched, light to mid brown, wall smooth and thick, septa very thick, in some conidia constricted at septa, dry, apex rounded to subacute, base rounded to obconicotruncate, usually 0–5-septate, (5)8–20(29) \times 2–4(5) μ m, hila 0.5–1.5 μ m wide, thickened (Figs. 2l–m, 3b–d and 4f).

Type On living leaves of *Ficus mysorensis* B. Heyne ex Roth (*Moraceae*), Sohagi Barwa Wildlife Sanctuary, Mahrajganj, eastern Uttar Pradesh, India, 22 March 2012, coll. Raghvendra Singh, AMH 9476 (holotype), GPU-KSR 600 (isotype).

Etymology Latin, *trichophila* refers to trichomes of leaves, the ecological niche where the fructification of the fungus is formed.

Discussion

Passalora trichophila are easily distinguishable from all other *Passalora* spp. [*P. bolleana* (Thüm.) U. Braun (\equiv *Septosporium bolleanum* Thüm.) on *Ficus carica*, *P. ficina* (S.K. Singh & R.K. Chaudhary) U. Braun & Crous (\equiv *Phaeoramularia ficina* S.K. Singh & R.K. Chaudhary) on *Ficus hererophyllae* and *P. urostigmatis* (Henn.) U. Braun & Crous (\equiv *Cercospora urostigmatis* Henn.) on *Ficus citrifolia* and *Urostigma* sp.] reported on the hosts of the same genus (Braun 1995, Crous and Braun 2003, Crous et al. 1998) (Fig. 5) by being a member of the former genus *Mycovellosiella*, i.e. by the formation of superficial hyphae giving rise to solitary conidiophores. The formation of superficial stromata is an additional striking character unknown in all other *Passalora* species on *Ficus* spp. Moreover, the conidia in *P. ficina* are formed in chains.

Some other cercosporoid species have been described on *Ficus mysorensis*, viz, *Scolecostigmina fici-elasticae* (J.N. Kapoor) U. Braun (Braun 1999), *Scolecostigmina fici-mysorensis* (Muthappa) U. Braun (Braun 1999), *Scolecostigmina maculata* (Cooke) U. Braun (Braun 1999), but all these species are different from *P. trichophila* due to strictly immersed mycelium, formation of sporodochia which are immersed to erumpent, subglobose to somewhat aplanate stromata, densely arranged and conidiophores, subcylindrical or somewhat attenuated towards the apex, usually verruculose, arising from stroma cells, reduced to a single conidiogenous cell, percurrently proliferating, conspicuously annellate, with unthickened conidiogenous loci.

Key to *Passalora* species on *Ficus* spp

1. External stroma and mycelium formed, conidiophores arising from superficial hyphae
P. trichophila
- 1* Stroma and mycelium only internal, solitary conidiophores lacking
 - 2 Conidia solitary to catenate, catenation simple to branched
P. ficina
 - 2* Conidia solitary
 - 3 Conidiophores mostly reduced to conidiogenous cells, conidia (11)17–25(35)×(3)4–5(5.5) μm
P. urostigmatis
 - 3* Conidiophores at least partly septate, i.e. conidiogenous cells integrated, terminal, conidia 10–40(70)×4.5–6 μm
P. bolleana

Acknowledgments We are grateful to an anonymous reviewer for helpful remarks on the manuscript. We are much obliged to the Head of the Department of Botany, DDU Gorakhpur University, Gorakhpur and the Director, Birbal Sahni Institute of Palaeobotany, Lucknow, for providing library and laboratory facilities. We thank the technical staff, Subodh Kumar for scanning electron microscopy. Authors' thanks are also due to the Curator, HCIO, New Delhi, for accepting the holotype specimens and providing an accession number thereof.

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