

RESEARCH ARTICLE

New species of genus *Asterina* (Asterinaceae) from Western Ghats, IndiaBhise MR^{1*}, Patil CR² and Salunkhe CB¹¹Post Graduate Centre of Botany, Krishna Mahavidhyalaya, Shivnagar, Rethare (BK.), Dist. Satara-415108, Maharashtra, India.²Department of Botany, Dattajirao Kadam Arts, Science and Commerce College, Ichalkaranji, Dist. Kolhapur - 416115, Maharashtra, India.

*Corresponding Author Email: mahendrabhise17@gmail.com

Manuscript details:	ABSTRACT
<p>Received: 04 January, 2015 Revised : 20 February, 2015 Accepted: 28 February, 2015 Published : 30 March, 2015</p> <p>Editor: Dr. Arvind Chavhan</p> <p>Cite this article as: Bhise MR, Patil CR and Salunkhe CB (2015) New species of genus <i>Asterina</i> (Asterinaceae) from Western Ghats, India, <i>Int. J. of Life Sciences</i>, 3(1): 67-75.</p> <p>Acknowledgements: The authors are grateful to authorities of Maharashtra State Biodiversity Board, Nagpur (M.S.) for granting permission for collection of plant material from study area. Thanks are due to Prof. S. R. Yadav and Dr. M. M. Lekhak, Dept. of Botany, Shivaji University, Kolhapur for providing the micro-photography facility; Principal, D.K.A.S.C. College, Ichalkaranji and Principal, Krishna Mahavidhyalaya, Shivnagar, Rethare (BK.), Dist. Satara, for providing the laboratory facilities.</p> <p>Copyright: © 2015 Author(s), This is an open access article under the terms of the Creative Commons Attribution-Non-Commercial - No Derivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.</p>	<p>The present paper deals with three new species of genus <i>Asterina</i> (Asterinaceae) belonging to black mildew fungi, collected on rarely occurring host plants from Mahabaleshwar, Maharashtra, India. These are, <i>Asterina beilschmiediae</i> sp. nov. on <i>Beilschmiedia dalzellii</i>, <i>A. hosagoudarii</i> sp. nov. on <i>Litsea josephii</i> and <i>A. oxyceri</i> sp. nov. on <i>Oxyceros rugulosus</i>. The detail morphological description, colour photographs, line drawings and discussions of these newly described species are provided in this paper.</p> <p>Key words: Black mildews, fungi, Mahabaleshwar, Maharashtra, taxonomy.</p> <p>INTRODUCTION</p> <p>Asterinaceous fungi are inconspicuous, foliicolous, superficial, obligate parasites and host specific black mildews, mostly found in the tropical and subtropical regions of the world (Hosagoudar, 2012). These fungi are characterized by forming thin to dense black colonies on the surface of the host leaves and mycelium, with lateral appressoria forming intracellular haustoria; dimidiate thyriothecia dehisced stellately at the center, at their maturity; asci bitunicate, 4 to 8-spored; ascospores pale to dark brown, transversely uniseptate, smooth or finely ornamented (Hofmann and Piepenbring, 2008; Hosagoudar, 2012).</p> <p>The genus <i>Asterina</i> Lev. is the largest genus of the family Asterinaceae, comprising more than 578 species (Hosagoudar and Abraham, 2000; Hosagoudar, 2012). The literature survey revealed that, the rich diversity of <i>Asterina</i> spp. was found on the host of angiosperms families like, Lauraceae (ca. 20 spp.) and Rubiaceae (ca. 25 spp.) from the tropical and subtropical regions of the world (Hosagoudar and</p>

Abraham, 2000; Hosagoudar, 2012; Far and Rossman, 2014). During the exploration of black mildew fungi from Mahabaleshwar and its surrounding area, three undescribed species of *Asterina* are recorded on rarely occurring host plants; of which, *Asterina beilschmiediae* sp. nov. on *Beilschmiedia dalzellii* (Meissn.) Kosterm., *A. hosagoudarii* sp. nov. on *Litsea josephii* S.M. Almeida (= *L. stocksii* (Meissn.) Hook. f) from family Lauraceae and *A. oxyceri* sp. nov. on *Oxyceros rugulosus* (Thw.) Tirveng. from family Rubiaceae, are reported here as new species.

MATERIALS AND METHODS

The leaves and twigs of host plants, infected with black mildews were collected during several field trips from study area during winter season (2013–2014). Host plants were identified using the regional flora (Deshpande *et al.*, 1995). The specimens were air-dried and preserved in standard size herbarium packets. Both macro and micro-morphological characters are used for taxonomical studies of collected fungi. Microscopic preparations were made in lactophenol, stained with cotton blue and observed under compound light microscope. To study the entire colony, mycelial branching and position of appressoria in its natural condition, a drop of peeling solution (Xylene–Thermocol solution) was applied on selected colonies, and after drying, the film was mounted directly again in the same solution (Bhise *et al.* 2014). Biometric data were based on the minimum to maximum values of 20 measurements of micro-morphological structures; illustrations were prepared with a mirror type Camera Lucida and photographed under Leica DM2000 fluorescence microscope, equipped with digital camera. The fungal specimens were identified by using standard literature (Stevens and Ryan, 1939; Hosagoudar and Abraham, 2000; Hosagoudar, 2012; Far and Rossman, 2014). Type specimens were deposited in Herbarium Cryptogamae Indiae Orientalis (HCIO), IARI, New Delhi (India) for their accession and the detail description and illustration of each newly described species were deposited in MycoBank. The detail taxonomic description, colour photographs, line drawings, comparative account and discussion of each new species are provided in the present paper.

RESULTS AND DISCUSSION

Taxonomy

1. *Asterina beilschmiediae* Bhise, Patil and Salunkhe, sp. nov. (Fig. 1)

MycoBank No. MB811704

Type: India, Maharashtra: Mahabaleshwar, on living leaves of *Beilschmiedia dalzellii* (Lauraceae), 17°55'25.6"N, 73°38'16.5"E, elev. 1289 m, 05.02.2014, Bhise M.R., HCIO 51713 (holotype).

Etymology: The specific epithet is based on the host plant genus.

Colonies hypophyllous, dark black, thin, circular to spreading, isolated, up to 10 mm in diameter. Hyphae dark brown, substraight to flexuous, thin, branching opposite to alternate at wide angles, loosely reticulate; cells 21–35 × 6 µm in size. Appressoria alternate to unilateral, moderately placed, unicellular, angular to irregularly lobed, entire, 11–13 × 13–15 µm. Thyriothecia scattered, globose to orbicular, stellately dehisced at the center, inner content not so yellow, up to 217 µm in diameter, margin fimbriate with fringed hyphae. Asci numerous, initially globose, subglobose to ovate at maturity, bitunicate, 8-spored, 54–72 × 45–50 µm. Ascospores oblong, conglobate, uniseptate, constricted at the septum, cells equal, globose at both ends, olivaceous brown, 32–39 × 14–16 µm, wall prominently echinulate.

Habitat and Distribution: Inhabiting living leaves of *Beilschmiedia dalzellii*, a rarely occurring plant in evergreen and semi-evergreen forests along the ghats at Mahabaleshwar, Maharashtra, India.

Notes: About 20 species of *Asterina* have been described on the members of family Lauraceae from the world (Hosagoudar and Abraham, 2000; Hosagoudar, 2012; Far and Rossman, 2014). The present new species can be compared with earlier described species of *Asterina* viz. *A. cinnamomicola* Hansf., *A. munnarensis* Hosag., *A. neolitsicola* Hosag., C.K. Biju & Abraham, *A. cryptocariicola* Hosag., C.K. Biju & Abraham, *A. litseae* Yates and *A. litseae-ligustrinae* Hosag., Balakr. & Goos known from Australia, India, Philippines and Sri Lanka on hosts of Lauraceae, based on the characters having alternate, unicellular, angular to lobate appressoria and smooth walled to echinulate

ascospores. After comparison, it is revealed that, the present collection differs from related species (*A. munnarensis*, *A. neolitsicola* and *A. litseae-ligustrinae*) in having thin, hypophyllous, large size colonies with distinctly irregularly lobed appressoria and prominently echinulate ascospores; as well as, larger

size of hyphal cells, appressoria, thyriothecia, asci and ascospores. Therefore, based on the host specificity and above distinguishing characters, it is treated as new species. Comparisons between the new species and its morphologically similar species are shown in Table 1.

Table 1: Comparative account of *A. beilschmiediae*, *A. munnarensis*, *A. neolitsicola* and *A. litseae-ligustrinae*

Sr. No.	Morpho-taxonomic characters	<i>Asterina beilschmiediae</i>	<i>Asterina munnarensis</i>	<i>Asterina neolitsicola</i>	<i>Asterina litseae-ligustrinae</i>
1.	Host Plant	<i>Beilschmiedia dalzellii</i>	<i>Cinnamomum</i> spp.	<i>Neolitsea</i> spp.	<i>Litsea ligustrina</i>
2.	Colonies	Hypophyllous, thin, up to 10 mm in diam.	Hypophyllous, thin to subdense, up to 10 mm in diam.	Hypophyllous, thin to subdense, up to 10 mm in diam.	Hypophyllous, up to 5 mm in diam.
3.	Hyphae	Substraight to flexuous, cells 21–35 × 6 μm	Straight to substraight, cells 12–20 × 2–3 μm	Flexuous to crooked, cells 12–18 × 3–5 μm	Straight to substraight, cells 15 – 22 × 3 – 5 μm
4.	Appressoria	Alternate to unilateral, unicellular, angular to irregularly lobed, 11–13 × 13–15 μm	Alternate, unicellular, angular to sublobate, 8–12 × 7–10 μm	Alternate, unicellular, globose to sublobate, 7–13 × 7–8 μm	Alternate to about 15% opposite, unicellular, conoid to sublobate, 9 – 13 × 6 – 10 μm
5.	Thyriothecia	Inner content not so yellow, up to 217 μm in diam.	Inner content golden yellow, up to 65 μm in diam.	Up to 75 μm in diam.	Inner content deep yellow, up to 110 μm in diam.
6.	Asci	Globose to ovate, 54–72 × 45–50 μm	Globose, up to 30 μm in diam.	Globose, 12–18 μm in diam.	Globose, 24 – 26 μm in diam.
7.	Ascospores	Conglobate, wall strongly echinulate, 32–39 × 14–16 μm	Conglobate, wall tuberculate, 17–20 × 7–8 μm	Conglobate, wall verruculose, 17–25 × 7–10 μm	Conglobate, wall echinulate, 18–19 × 6–10 μm,

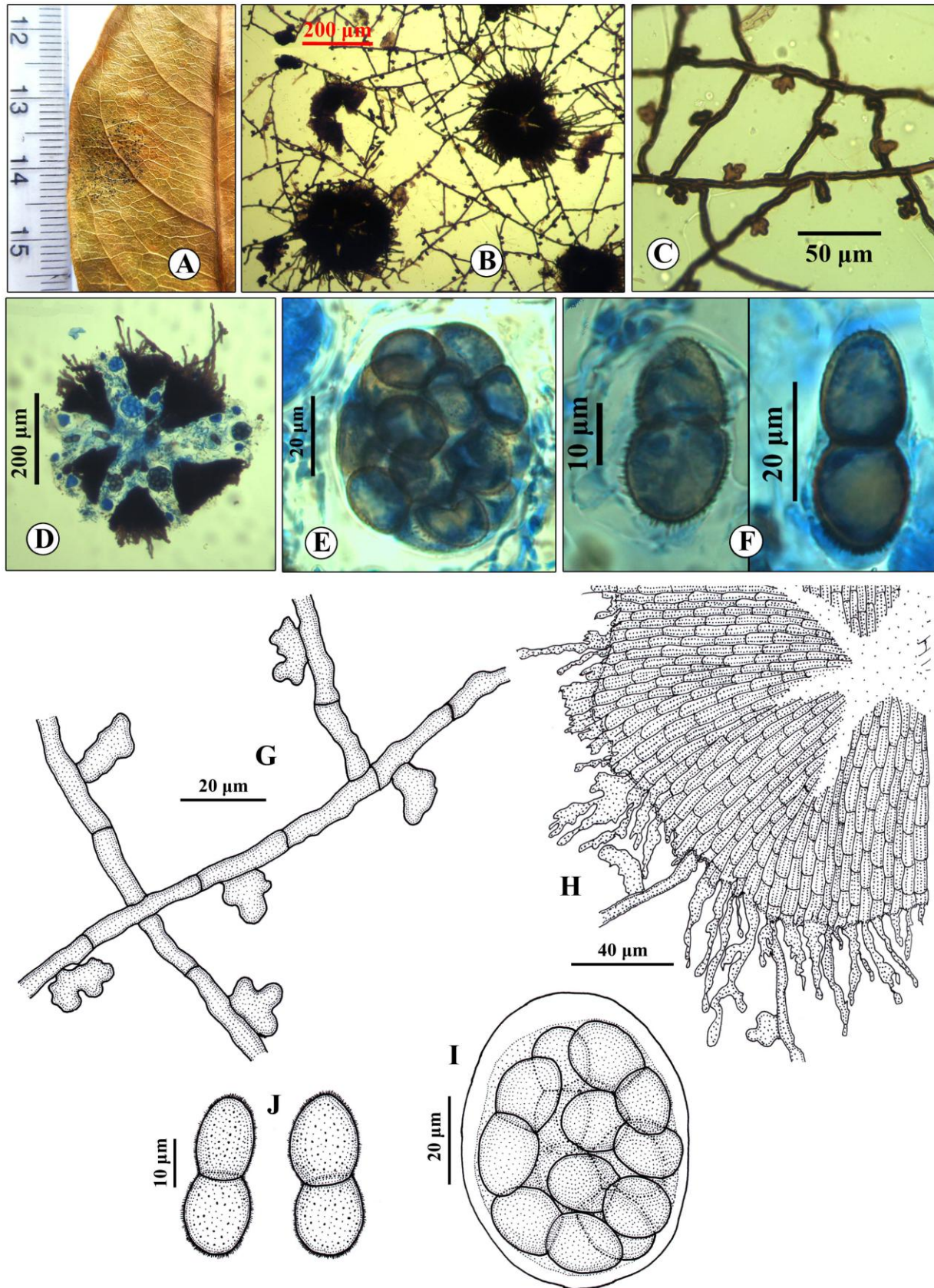


Fig. 1: *Asterina beilschmiediae* (holotype). A. Infected leaves; B. Mycelial colony with thyriothechia; C, G. Appressariate mycelium; D, H. Thyriothecium; E, I. Ascus; F, J. Ascospores.

2. *Asterina hosagoudarii* Bhise, Patil and Salunkhe, *sp. nov.* (Fig. 2)

MycoBank No. MB811705

Type: India, Maharashtra: Mahabaleshwar, Gureghar, on living leaves of *Litsea josephii* (Lauraceae), 17°55'19.23"N, 73°44'22.79"E, elev. 1284m, 19.11.2012, Bhise M.R. HClO 51658 (holotype); HClO 51657 (Isotype).

Etymology: Named after Dr. V. B. Hosagoudar, having major contribution in Asterinaceous fungi from India.

Colonies epiphyllous, dark black brown, thin, spreading on entire leaf surface. Hyphae pale brown, straight to undulate, branching opposite to alternate at wide angles, closely reticulate, wall slightly undulate; cells 10 – 23 × 3 – 5 µm in size. Appressoria opposite to alternate, mostly opposite, distantly arranged, unicellular, irregularly lobed to angular, mostly trilobed, 9 – 12 × 7 – 10 µm in size. Thyriothecia scattered, globose to orbicular, stellately dehisced at the center, margin fimbriate with fringed hyphae, inner content not so yellow, up to 168 µm in diam. Asci globose, subglobose to ovate, 4 to 6 in each thyriothecia, 8-spored, 25 – 36 × 20 – 33 µm in size. Ascospores oblong, conglobate, olivaceous brown, 1-septate, constricted at the septum, cells more or less equal, 20 – 23 × 9 – 11 µm, wall smooth.

Habitat and Distribution: Inhabiting living leaves of *Litsea josephii* (Lauraceae) rarely occurring plant in evergreen and semi-evergreen forests along ghats at Mahabaleshwar, Gureghar, Maharashtra, India.

Notes: About 20 species of *Asterina* have been described on the members of family Lauraceae from the world (Hosagoudar and Abraham, 2000; Hosagoudar, 2012; Far and Rossman, 2014). The present new species can be compared with earlier described species *Asterina litseae* Yates and *A. litseae-ligustrinae* Hosag., Balakr. & Goos reported on *Litsea deccanensis* and *L. ligustrina* respectively, from Nilgiris, Tamil Nadu, India (Hosagoudar, 2012), based on the characters having straight to undulate hyphae and alternate to opposite, unicellular, angular to lobate appressoria. However, the present new species differs from former species in having colonies epiphyllous only, appressoria mostly opposite, irregularly lobed or angular, inner content of thyriothecia not so yellow and smooth walled ascospores; also, larger size of thyriothecia, asci and ascospores. Hence, the present species is treated as new to science. Comparisons between the new species and its morphologically similar species are shown in Table 2.

The present species found to be associated with *Meliola litseae* Syd.

Table 2: Comparative account of *Asterina hosagoudarii*, *A. litseae* and *A. litseae-ligustrinae*

Sr. No.	Morpho-taxonomic characters	<i>Asterina hosagoudarii</i>	<i>A. litseae</i>	<i>A. litseae-ligustrinae</i>
1.	Host Plant	<i>Litsea josephii</i> (<i>L. stocksii</i>)	<i>L. deccanensis</i>	<i>L. ligustrina</i>
2.	Colonies	Epiphyllous, spreading on entire leaf.	Amphigenous, up to 5 mm diam.	Hypophyllous, up to 5 mm diam., rarely confluent.
3.	Hyphae	Straight to undulate, cells 10 – 23 × 3 – 5 µm	Straight to substraight, cells 12 – 22 × 3 – 5 µm	Straight to substraight, cells 15 – 22 × 3 – 5 µm
4.	Appressoria	Mostly opposite, irregularly lobed to angular, 9 – 12 × 7 – 10 µm	Alternate, conoid to ampulliform, 6 – 13 × 5 – 7 µm	Alternate, entire to variously sublobate, 9 – 13 × 6 – 10 µm
5.	Thyriothecia	Inner content not so yellow, up to 168 µm in diam.	Inner content deep yellow, up to 125 µm in diam.	Inner content deep yellow, up to 110 µm in diam.
6.	Asci	Globose to ovate, 25 – 36 × 20 – 33 µm	Globose, 18 – 25 µm in Diam.	Globose, 24 – 26 µm in Diam.
7.	Ascospores	20 – 23 × 9 – 11 µm, wall smooth	18 – 19 × 8 – 10 µm, wall smooth	18 – 19 × 6 – 10 µm, wall echinulate

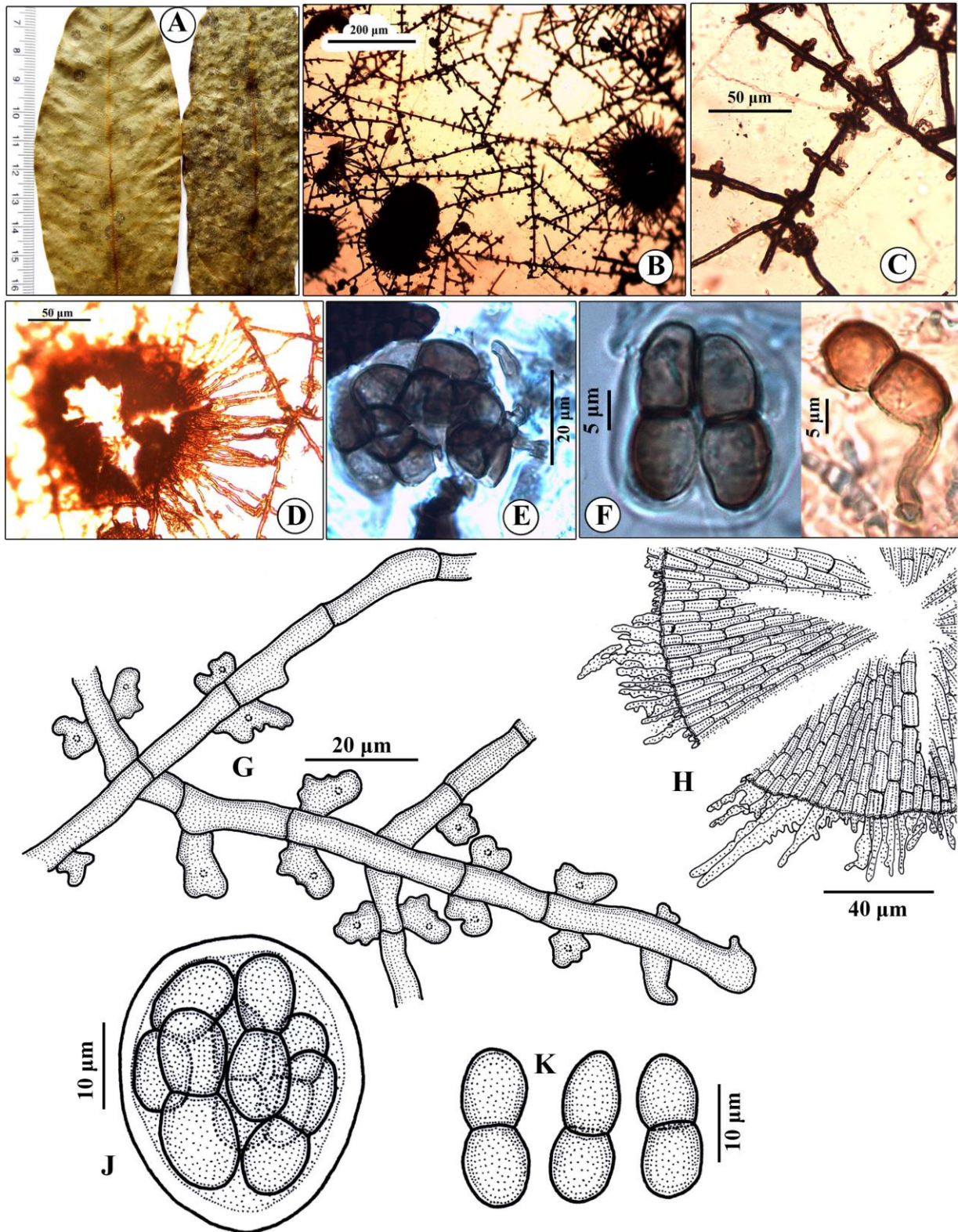


Fig. 2: *Asterina hosagoudarii* (holotype). A. Infected leaves; B. Mycelial colony with thyriothechia; C, G. Appressariate mycelium; D, H. Thyriothecium; E, J. Ascus; F, K. Ascospores.

3. *Asterina oxyceri* Bhise, Patil and Salunkhe, *sp. nov.* (Fig. 3)

MycoBank No. MB811706

Type: India, Maharashtra: Mahabaleshwar, Hatlote, on living leaves of *Oxyceros rugulosus*, 17°51'43.6"N, 73°35'33.8"E, elev. 742 m, 06.02.2014, Bhise M.R., HCIO 51719 (holotype).

Etymology: The specific epithet is based on the host plant genus.

Colonies amphigenous, brownish black, thin, circular to spreading, rarely confluent, up to 5 mm in diameter. Hyphae dark black to brown, straight to substraight, branching opposite to alternate at acute to wide angles, loosely reticulate; cells 25–32 × 6–8 µm in size. Appressoria opposite to rarely subopposite, closely arranged, antrorse to subantrorse, straight to curved, unicellular, conoid to obclavate, entire, 11–14 × 7 µm. Thyriothecia scattered, globose to orbicular, stellately dehisced at the center, up to 342 µm in diameter, margin fimbriate with fringed hyphae. Asci few, initially globose, subglobose to ovate at maturity, 8-spored, 50–70 × 36–46 µm. Ascospores oblong, conglobate, olivaceous brown, uniseptate, constricted

at the septum, cells equal, 31–34 × 12–14 µm, smooth walled.

Habitat and Distribution: Inhabiting living leaves of *Oxyceros rugulosus*, a rarely occurring plant in semi-evergreen and moist deciduous forests at Hatlote, Mahabaleshwar, Maharashtra, India.

Notes: About 25 species of *Asterina* have been described on the members of family Rubiaceae from the world (Hosagoudar and Abraham, 2000; Far and Rossman, 2014; Hosagoudar, 2012). The literature survey revealed that, the present species is close to *A. canthii* Yates, *A. canthii-dicocci* Hosag. and *A. psychotriicola* Hosag. & Archana described from Philippines and India (Stevens and Ryan, 1939; Hosagoudar, 2012), based on the characters in having opposite to alternate and unicellular appressoria. However, *Asterina oxyceri* is differs from the related species in having opposite to rarely subopposite, conoid to obclavate appressoria; larger size of thyriothecia, asci and ascospores. Therefore, based on the host specificity and above distinguishing characters it is treated as new species. Comparisons between the new species and its morphologically similar species are shown in Table 3.

Table 3: Comparative account of *Asterina oxyceri*, *A. canthii*, *A. canthii-dicocci* and *A. psychotriicola*

Sr. No	Morpho-taxonomic characters	<i>Asterina oxyceri</i>	<i>A. canthii</i>	<i>A. canthii-dicocci</i>	<i>A. psychotriicola</i>
1.	Host Plant	<i>Oxyceros rugulosus</i>	<i>Canthium</i> sp.	<i>Canthium dicoccum</i>	<i>Psychotria</i> sp.
2.	Colonies	Amphigenous, thin, up to 5 mm in diam.	Amphigenous	Amphigenous, up to 2 mm in diam.	Epiphyllous, up to 3 mm in diam.
3.	Hyphae	Straight to substraight, cells 25–32 × 6–8 µm	Straight, cells 12–20 × 2–3 µm	Straight, cells 32–36 × 5–7 µm	Flexuous, cells 9–35 × 3–5 µm
4.	Appressoria	Opposite to rarely subopposite, unicellular, conoid to obclavate, 11–14 × 7 µm	Opposite, unicellular, oblong to cylindrical, 4–5 × 5 µm	Alternate, ovate, oblong, cylindrical, often attenuated at the apex, 11–16 × 8–10 µm	Alternate, ovate to clavate, often attenuated at the apex, 8–13 × 6–11 µm
5.	Thyriothecia	Up to 342 µm in diam.	Up to 175 µm in diam.	Up to 160 µm in diam.	Up to 400 µm in diam.
6.	Asci	Globose to ovate, 50–70 × 36–46 µm	Globose, 30–40 × 8–10 µm	Globose, up to 35 µm in diam.	Globose, up to 30 µm in diam.
7.	Ascospores	Conglobate, wall smooth, 31–34 × 12–14 µm	Conglobate, wall smooth, 10–12 × 3–4 µm	Conglobate, wall smooth, 20–22 × 11–13 µm	Conglobate, wall strongly tuberculate, 20–24 × 9–13 µm

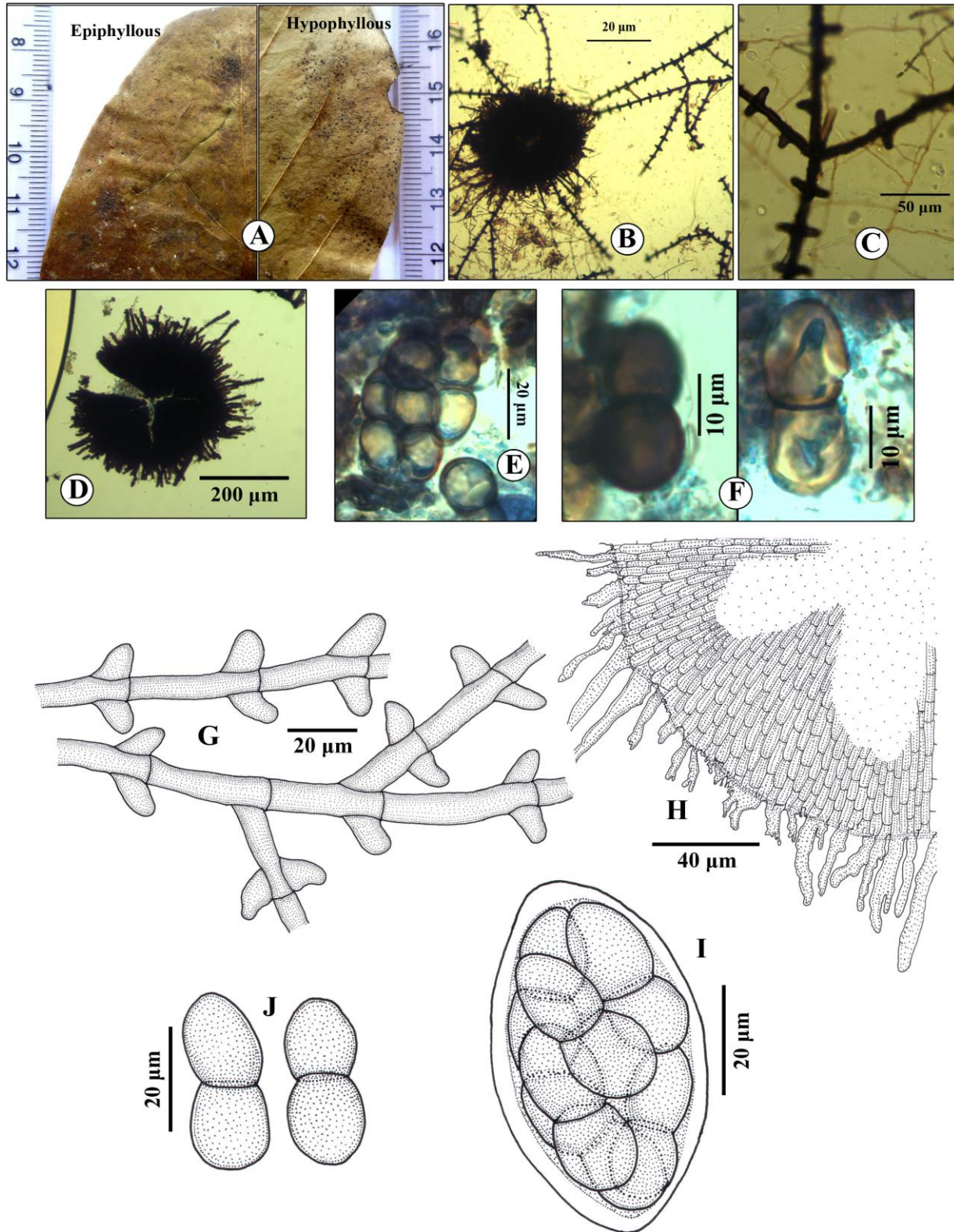


Fig. 3: *Asterina oxyceri* (holotype). A. Infected leaves; B. Colony with thyriothecia; C, G. Appressoriolate mycelium; D, H. Thyriothecium; E, I. Ascus; F, J. Ascospores.

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