

Taxonomy, distribution and statistical ecology of black mildew fungi reported from Maharashtra state of India

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Abstract. Dubey R, Moonambeth N, Pandey AD. 2022. Taxonomy, distribution and statistical ecology of black mildew fungi reported from Maharashtra state of India. *Asian J For* 6: 97-125. The Maharashtra state of India represents some of the best non-equatorial tropical forests in the world. It supports many endemic species of plants, animals, and microorganisms, especially in the Western Ghats, India. Moreover, a research project entitled "Follicolous fungi of Maharashtra" was allotted by the Botanical Survey of India, Ministry of Environment, Forests, and Climate change, India, to carry out the mycological studies. As part of this project, ongoing studies were carried out on black mildew fungi of this state. The present studies offer a taxonomic account, distribution, and ecological parameters of 72 black mildew taxa collected from different areas of Maharashtra state of India. The present study provides three new records of fungi to India, 31 new host records to India, 40 new records of fungi to the Maharashtra state of India, and one new variety, viz., *Asterina jasmini* Hansf. var. *koyani* var. nov., depicted by checklist and Figures. In addition, a comprehensive table containing information on location, date of collection, name of the collector, and new records are given for ready reference. During this study, *Meliola* was the dominant genus with 35 species, whereas *Meliolina mollis* was the dominant taxon obtained from a maximum of 5 collections. More than 90% of black mildew species are collected from the Western Ghats Districts. In diversity indices, Gini-Simpson's was 0.9818, and Shannon's was 4.1668. Pielou's evenness index was 0.9743, causing true diversity, calculated as an effective number of species (64), to be less than observed species richness (72).

Keywords: Asterinales, checklist, diversity indices, Meliolales, new records, taxonomy

INTRODUCTION

The state of Maharashtra is located in the northwestern part of peninsular India. It lies between 15°35'N and 22°02' N latitudes and 72°36'E and 80°54'E longitudes. Maharashtra occupies an area amounting to 307731 km², which comprises about 9.4% of the total area of India. The elevation in the state ranges from sea level to 1646 m. The state may be divided into three natural divisions according to physiography, viz., the narrow coastal strip of land, known as Konkan, lying between the Arabian Sea and the Western Ghats, the Western Ghats, and the Deccan Plateau. The Western Ghats is considered one of the 'Biodiversity Hotspots' of the world (Myers et al. 2000), showing high endemism in flora and fauna. From Dhule and Nandurbar in the north to the districts of Sindhudurg and Kolhapur in the south, the Western Ghats in Maharashtra passes 13 districts. Vegetation of the state was classified by Champion and Seth (1968) into the following five categories; (i) Tropical semi-evergreen forests, (ii) Tropical moist deciduous forests, (iii) Tropical dry deciduous forests, (iv) Tropical thorn forests, (v) Littoral and swamp forests. Black mildews are a group of black colony-forming parasitic fungi; most are obligate biotrophs, but a few are necrotrophs and host-specific with a very narrow host range. Since these fungi do not cause any appreciable pathogenicity in plants, not much attention has been paid to this group. However, due to higher temperatures in the parts infected by black mildew colonies, plant respiration is

higher, causing reduced photosynthetic efficiency due to the lower efficiency of chlorophyll, leading to effects such as lower production of total sugar.

Black mildews are especially abundant in the tropics (Hansford 1956) and mostly infest the dicotyledonous Angiosperms (>90%). In addition, they also infect monocotyledons, Gymnosperms, and Pteridophytes. Black mildew belongs to the family Meliaceae, Asterinaceae, Englerulaceae, and Parodiopsidaceae in the Ascomycota. Order Meliolales contains more than 1,580 species (Hawksworth et al. 1995), most of which (1,400) are in the genus *Meliola* (Parbery and Brown 1986). Asterinaceous fungi are host specific because they must circumvent, tolerate and overcome the specific resistance factors of the particular host (Chandraprabha et al. 2011). The species concept of Asterinaceous fungi was based on the respective host plants and also on the morphological aspects of the fungus (Doidge 1942; Hansford 1946, 1956; Hosagoudar and Abraham 1996, Hosagoudar 2012). With its tropical climate and diverse flora, India provides favorable conditions for many black mildew fungi growth. Keys to the genera of black mildew fungi can be found in Muller and von Arx (1973), whereas species descriptions and illustrations are in monographic treatments by Hansford (1961, 1963).

The biogeographical distribution of Meliaceae members in India was described and illustrated by Hosagoudar in Meliolales of India, published in three volumes (Hosagoudar 1996, 2008, 2013). Asterinales of

India is well studied and illustrated by Hosagoudar (2012). The Black mildew fungi were mainly studied from Mahabaleshwar (Satara) in Maharashtra (Patil et al. 2014; Bhise et al. 2015, 2021). Nilgiris, Anamalai, Seithur hills, Kothayar, etc., from Tamil Nadu; mainly from Kodagu in Karnataka; and most of the places in the Western Ghats of Kerala State. The Maharashtra state of India represents some of the best non-equatorial tropical forests in the world. It supports many endemic species of plants, animals, and microorganisms, especially in the Western Ghats. herefore, persistent efforts were put in by a team of researchers to explore Maharashtra's foliicolous fungi over six years, from 2010 to 2016. In the present study, various areas were visited in different forest ecosystems of Maharashtra, and the live leaves having black mildew infections were collected. The outcome is the present work in the form of the consolidated account of the Black mildew fungi of Maharashtra.

MATERIALS AND METHODS

Study area

During the field survey, all the major forest types within Maharashtra, India, were visited. However, priority was given to densely forested areas, as evident from the Maharashtra portion of the forest map of India (Forest Survey of India 2021), shown in inset (B) of Figure 1. These areas were prioritized as they are crucial from a conservation perspective, including Western Maharashtra (encompassing biodiversity hotspots of Western Ghats) and tiger reserves of Northern Maharashtra. The surveyed areas include protected areas of wildlife sanctuaries (WLS) viz., Bhimashankar WLS, Dajipur WLS, Koyana WLS, Phansad WLS, Radhanagari WLS, Toranmal WLS; national parks viz., Sanjay Gandhi National Park, Chandoli National Park; Tiger Reserves of Melghat and Pench. The surveyed areas also include forest areas of districts of Ahmednagar, Amravati, Kolhapur, Mumbai (Suburban), Nagpur, Nandurbar, Pune, Raigad, Ratnagiri, Sangli, Satara, Sindhudurg, and Thane.

Procedures

Infected plant parts were carefully noticed in the field, and field notes were made regarding their pathogenicity, nature of colonies, infection, locality, altitude, etc. In the field, each infected plant was collected separately in polythene bags. These infected plant parts were pressed neatly and dried in-between blotting papers. After ensuring their dryness, they were kept in the butter paper folders. GPS data of collection locations were recorded during field tours. The GPS data was used to make a survey map (Figure 1) with QGIS 2.8 Wien version for microscopic study. Scrapes were taken directly from the infected host and mounted in a 10% KOH solution. After 30 minutes, KOH was replaced by Lacto phenol, prepared according to Rangaswamy (1975). The host plants were identified by consulting the experts. The nail polish technique (Hosagoudar and Kapoor 1985) was used to study the entire colony in its natural condition. Digital images were

taken using a Digital color CCD Camera (Nikon DS Fi1) attached to a Nikon eclipse 50i microscope with interference optics. All the foliicolous samples are maintained systematically in the Botanical Survey of India, Western Regional Centre Herbarium, Pune (BSI). Meliolales of India vols. I-III (Hosagoudar 1996, 2008, 2013) as Asterinales of India (Hosagoudar 2012) were consulted to identify Black mildew fungi. The documented genera and species were classified as per Index fungorum and Mycobank online database and the 10th edition of Dictionary of Fungi.

Data analysis

Aspects of microfungal ecology at the diversity indices level were analyzed, consistent with, for instance, Dubey and Pandey (2022a,b). First, at the level of diversity indices, information on several species and many isolates was combined to calculate two widely used measures of fungal diversity. Next, to calculate a measure of evenness, and finally, to calculate true diversity by converting Shannon's Index into an effective number of species.

Simpson's Index (Jost 2006) measures the probability of two randomly selected isolates belonging to the same species. It takes values from 0 to 1. The formula gives it:

$$\text{Simpson's Index } (D) = \sum_{i=1}^S p_i^2$$

Where $p_i (= n_i/N)$ is the proportion of i^{th} species, n_i = number of isolates of i^{th} species, N = total number of isolates of all species, and S = number of distinct species. Thus, the lower the index value, the lower the probability of two isolates belonging to the same species, thus the higher the diversity, and vice versa. However, such an interpretation tends to be counterintuitive. Hence, its complement $(1-D)$, known as Gini-Simpson's Index (Jost 2006), which follows naturally from the laws of probability, has been used, which is easy and intuitive in terms of interpretability, as higher values correspond to higher diversity.

$$\text{Gini Simpson's Index } (1-D) = 1 - \sum_{i=1}^S p_i^2$$

Shannon's Index (Jost 2006) quantifies the uncertainty (or entropy) associated with correctly predicting the species to which the next isolate belongs. Therefore, the higher the value, the more the uncertainty, thereby higher the diversity. It is calculated as follows:

$$H = \sum_{i=1}^S p_i \ln(1/p_i)$$

Where: \ln = natural logarithm, while others are the same as in Simpson's Index.

Pielou's evenness index. J' (Pielou 1995) is a measure of species evenness. It is a normalized Shannon's index, bounded by zero and one. Higher values correspond to more equitable distribution, with $J'=1$ representing perfectly equitable distribution where all species are equally abundant. It is given by:

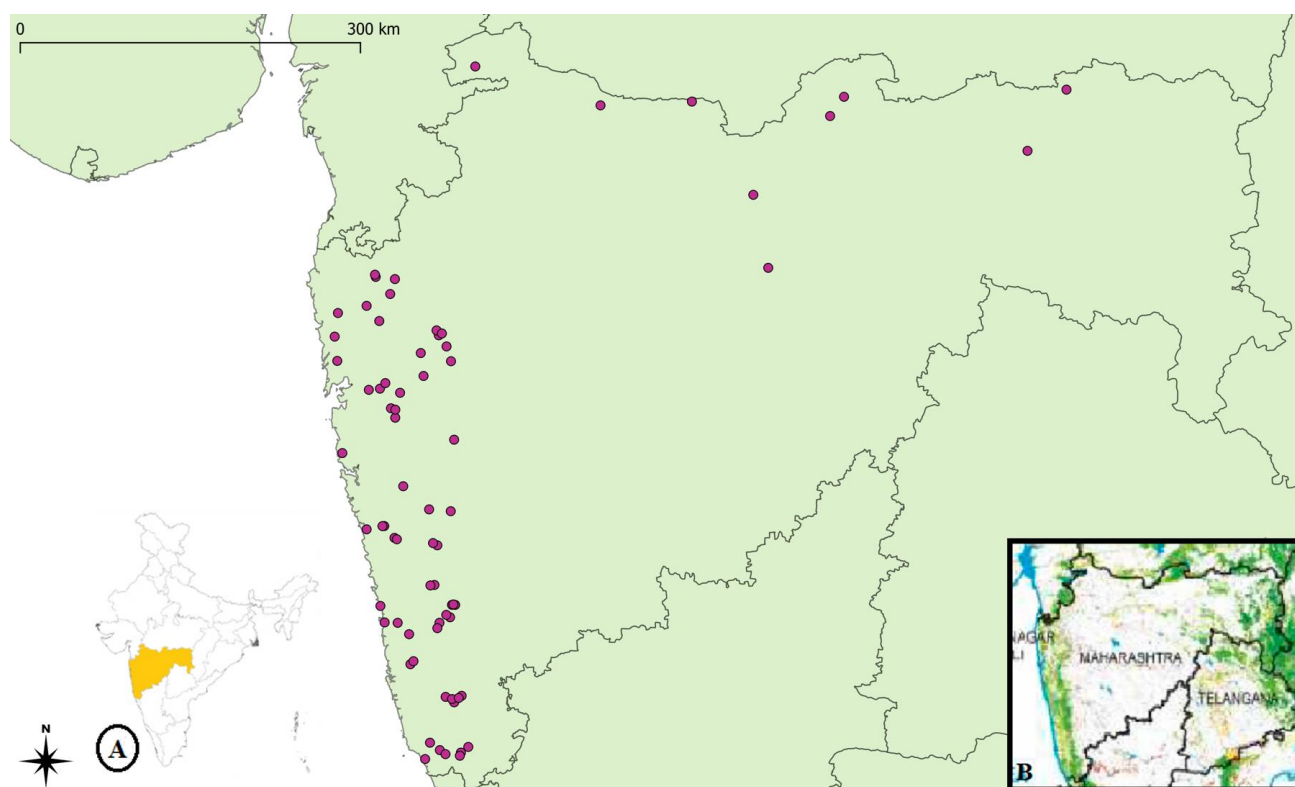


Figure 1. Collection locations in different districts of Maharashtra, India, and inset (A) Location of Maharashtra state in India (B) Forest map of Maharashtra, India (Source: Forest Survey of India 2021)

$$J' = \frac{H}{\ln(S)}$$

Next, we examine true diversity by calculating the effective number of species obtained by correcting species richness (observed number of species) by incorporating evenness (number of isolates). The effective number of species, calculated from a diversity index, is the equivalent number of equally abundant species in a hypothetical assemblage for the same value of the given diversity index (Gotelli and Ellison 2004). True diversity is obtained by transforming Shannon's Index (H) as follows (Jost 2006):

$$ENS_H = e^H$$

Where, ENS_H is the effective number of species, and 'e' is Euler's number or natural base. ENS_H is usually rounded down to the nearest integer for a meaningful interpretation. We use Shannon's Index (H) for calculation as it weighs both common and rare species equally, unlike Simpson's Index and species richness which overweigh common species and rare species, respectively (Gotelli and Ellison 2004).

MS Excel was used for the statistical analysis carried out in the present paper.

RESULTS AND DISCUSSION

Taxonomy and checklist of black mildew fungi identified

A total of 72 species, documented under 14 genera, were identified from 87 collections which are well illustrated in Figure 2 to Figure 73. The study provides 3 new records of fungi to India, 31 new host records to India, 40 new records to the Maharashtra state of India, and one var. nov. *Asterina jasmini* Hansf. var. *koyani* var. nov. (Table 1).

Amazonia elaeocarpi Hosag., D.K. Agarwal, H. Biju & Archana, *Indian Phytopath.* 60 (1): 82 2007. Figure 2

Fungi, Ascomycota, Pezizomycotina Sordariomycetes, Incertae sedis, Meliolales, Meliolaceae.

Specimen examined: On the leaves of *Leea indica* (Burm. f.) Merr. (Vitaceae), Kesari, Sawantwadi Tal. Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200117 BSI (WC).

Remarks: This is the first instance of the fungus being encountered as foliicolous on the leaves of *L. indica*. Further, no species of *Amazonia* is reported on *L. indica*. Therefore, this is a new host record for India and a new fungus record in Maharashtra.

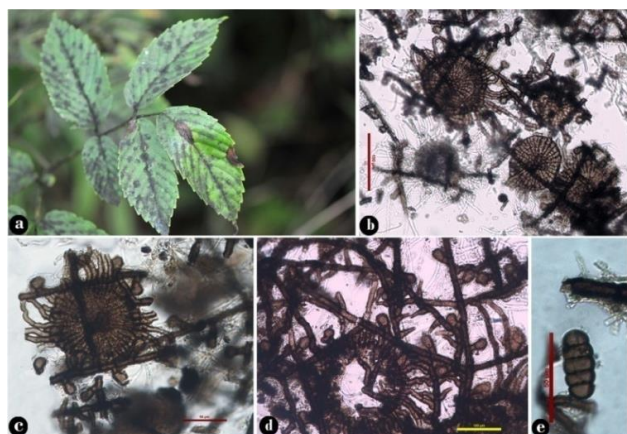


Figure 2. *Amazonia elaeocarpi* (a) Sooty mold of *Leea indica* (b-c) Perithecia hidden in radiating Mycelium (d) Mycelium with perithecia, appressoria, and phialides (e) Ascospore. [Scale bar: (b, d) = 100 µm; (c, e) = 50 µm.]

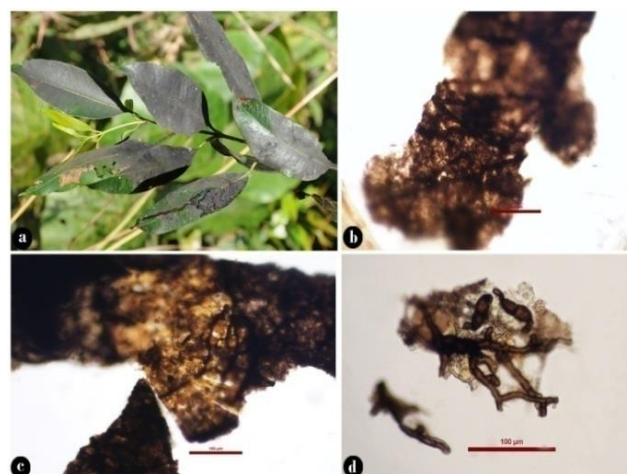


Figure 3. *Amazonia syzygii* (a) Sooty mold of *Syzygium cumini* (b-c) Perithecia hidden in radiating Mycelium (d) Ascospores. [Scale bar: (b-d) = 100 µm.]

Amazonia syzygii Hosag. & Goos, *Mycotaxon* 36 (1): 236 1989. Figure 3

Specimen examined: On the leaves of *Syzygium cumini* (L.) Steels (Myrtaceae), Location 1, Metindoli, Koyana WLS, Satara Dist., Maharashtra, India, 13.02.2015, RD, 201751 BSI (WC).

Known distribution: There are certain reports of association of the fungus on leaves of *S. cumini*, Kerala (Hosagoudar and Pillai 1993); on leaves of *Syzygium* sp., Tamil Nadu (Hosagoudar 1996).

Remarks: This is the first instance of fungus from the Maharashtra region of the Western Ghats.

Asteridiella depokensis (Hansf.) Hansf., *Sydowia* 16 (1-6): 321 1963. Figure 4 = *Irenina depokensis* Hansf., *Reinwardtia* 3 (1): 109 1954)

Fungi Ascomycota, Pezizomycotina Sordariomycetes, Incertae sedis, Meliolales, Meliolaceae.

Specimen examined: On the leaves of *Vitex negundo* L. (Lamiaceae), Kudal, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200081 BSI (WC).

Known distribution: On leaves of *V. negundo* (Verbenaceae), Hoddur, C. Jagath Thimmaiah (Thimmaiah et al. 2013).

Remarks: This is the first record of the fungus in Maharashtra state.

Asteridiella mallotica (W. Yamam.) Hansf., *Beih.*

Sydowia 2: 211 1961. = *Irenina mallotica* W. Yamam., *Trans. Nat. Hist. Soc. Formosa* 30: 415 1940. Figure 5

Specimen examined: On the leaves of *Mallotus Philippensis* (Lam.) Muell Arg. (Euphorbiaceae), Location 2, Kusapur, Koyana WLS, Satara Dist., Maharashtra, India, 13.02.2015, RD, 201772 BSI (WC).

Known distribution: Reported on leaves of *M. philippensis* from Kerala (Hosagoudar and Goos 1989).

Notes: A total of 33 species of *Asteridiella* have been reported from India.

Remarks: This is the first record of the fungus in the Maharashtra region of the Western Ghats.



Figure 4. *Asteridiella depokensis* (a) Black mildews of *Vitex negundo* (b-c) Perithecia with mammiform wall (d-e) Mycelium with appressoria & phialides (f-g) Ascospores. [Scale bar: (b-c) = 100 µm, (d-g) = 50 µm.]

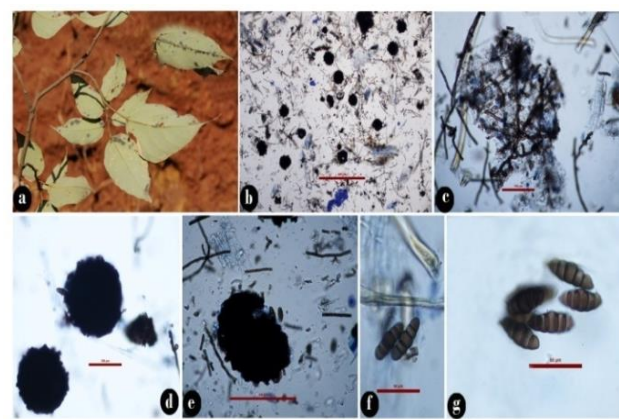


Figure 5. *Asteridiella mallotica* (a) Black mildews of *Mallotus philippensis* (b) Colonies with Perithecia (c) Mycelia with both appressoria & Phialides (d-e) Perithecia with ascospores (f-g) Ascospores. [Scale bar: b = 500 µm, (c-e) = 100 µm, (f-g) = 50 µm.]

Asterina capparis Syd., P. Syd. & E.J. Butler
[as '*capparidis*'], *Annls mycol.* 9 (4): 390 1911. Figure 6

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Dothideomycetidae, Asterinales, Asterinaceae.

Specimen examined: On the leaves of *Capparis* sp. (Capparaceae), Amboli Ghat, Sindhudurg Dist., Maharashtra, India, 22.01.2012, RD, 200224 BSI (WC).

Known distribution: Earlier reported on various species of *Capparis* from Karnataka, Tamil Nadu, and Uttar Pradesh (Maheshwari et al. 2012).

Remarks: This is the first record of the fungus in Maharashtra state.

Asterina delicatula Syd., P. Syd. & Bal in Sydow, *Annls mycol.* 19 (5-6): 308 1921). Figure 7

Specimen examined: On the leaves of *Jasminum* sp. (Oleaceae), Sawantwadi, Sindhudurg Dist., Maharashtra, India, 20.01.2012, RD, 200075 BSI (WC).

Known distribution: Reported on *Aegle marmelos* (L.) Corrêa from India (Hosagoudar 2012)

Remarks: This is the first record of the fungus in Maharashtra state, and also *Jasminum* sp. is a new host genus for *A. delicatula*.

Asterina henianii Verma, Tripathi & Chaudhary *Indian Phytopath.* 52 (4): 377 1999. Figure 8

Specimen examined: On the leaves of –

Syzygium sp. (Myrtaceae), Location 1, Dajipur WLS, Kolhapur Dist., Maharashtra, India, 09.02.2015, RD, 177201620 BSI (WC).

Syzygium cumini (L.) Skeels (Myrtaceae), Location 2, Dajipur WLS, Kolhapur Dist., Maharashtra, India, 09.02.2015, RD, 201642 BSI (WC).

Known distribution: Review of the literature reveals that *A. henianii* is reported on leaves of *Syzygium henianum* (Myrtaceae), Uttar Pradesh (Verma et al. 1999).

Remarks: This is the first record of the fungus from Maharashtra.

Asterina hydrocotyles Hosag. & CK Biju *Indian Phytopath.* 58 (2): 198 2005. Figure 9

Fungi Ascomycota, Pezizomycotina Sordariomycetes, Incertae sedis, Meliolales, Meliolaceae.

Specimen examined: On the leaves of *Lawsonia inermis* L. (Lythraceae), Junnar, Pune Dist., Maharashtra, 21.09.2013, RD, 196234 BSI (WC).

Known distribution: Earlier reported on leaves of *Hydrocotyle* sp., Kerala and Tamil Nadu (Hosagoudar, 2012); on leaves of *Hydrocotyle javanica* Thumb. (Nithyatharani 2008).

Remarks: This is the first record of the fungus in Maharashtra, and also, *L. inermis* forms a new host genus record for *A. hydrocotyles*.

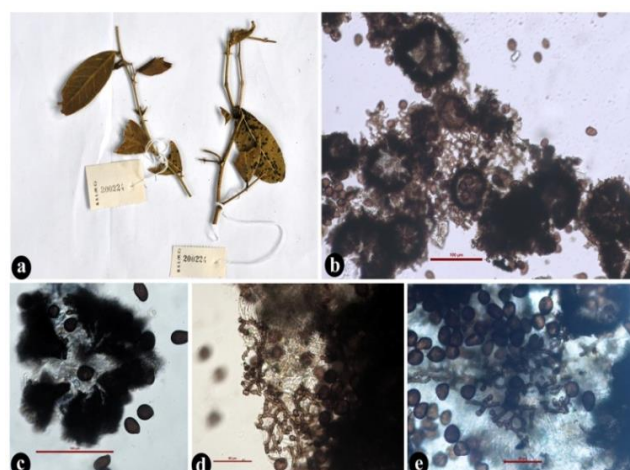


Figure 6. *Asterina capparis* (a) Black mildews of *Capparis* sp. (b) Colonies with *Thyriothezia* and *Pycnothyria* (c) *Pycnothyria* with pycnothyriospores (d-e) *Pycnothyria* with appressoria (e) *Pycnothyriospores*. [Scale bar: (b-c) = 100 µm, (d-e) = 50 µm.]

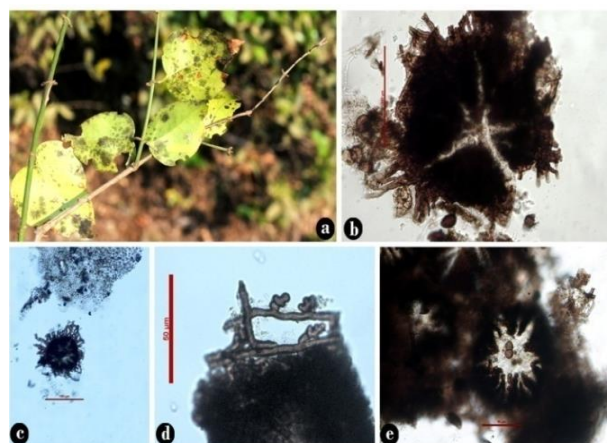


Figure 7. *Asterina delicatula* (a) Black mildews of *Jasminum* sp. (b-c) Mycelium with *thyriothezia* (d) Two-celled appressoria (e) *Thyriothezia* with ascospores. [Scale bar: (b-c) = 100 µm, (d-e) = 50 µm.]

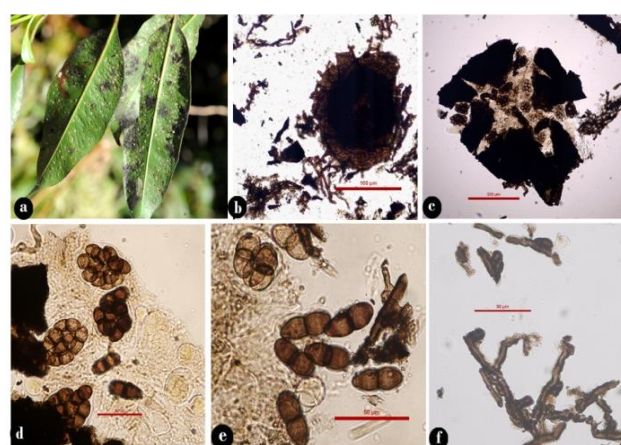


Figure 8. *Asterina henianii* (a) Black mildews of *Syzygium* sp. (b) *Thyriothezia* (c) Dehiscent *thyriothezia* (d) *Ascus* (e) *Ascospores* (f) Mycelium with *Appressoria*. [Scale bar : b = 100 µm, c = 200 µm, (d-f) = 50 µm.]

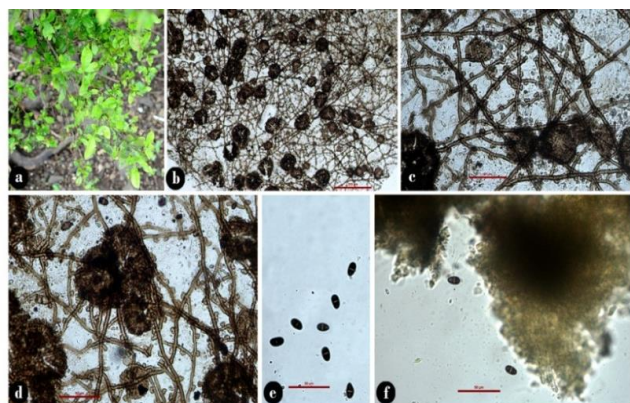


Figure 9. *Asterina hydrocotyles* (a) Infected leaves of *Lawsonia inermis* (b) Mycelia with thyriothechia and appressoria (c) Thyriothechia with appressoria and phialides (d) Pycnothyria with pycnothyriospores (e-f) Pycnothyriospores with a hyaline band at the center. [Scale bar : b = 200 μ m, (c-f) = 50 μ m.]

Asterina jambolanae A.K. Kar & Maity. *Trans. Br. mycol. Soc.* 54 (3): 438 (1970). Figure 10

Specimen examined: On the leaves of *Eugenia* sp. (Myrtaceae), Kesari, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200100 BSI (WC).

Known distribution: India – Asterinales of India by Hoasagoudar (2012) referenced the distribution of *A. jambolanae* from Kerala, Karnataka, Uttar Pradesh, Tamil Nadu, and West Bengal (Hosagoudar 2012).

Remarks: This is the first record of the fungus in Maharashtra.

Asterina jasmini Hansf. var. *koyani* var. nov. Rashmi Dubey Figure 11

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Dothideomycetidae, Asterinales, Asterinaceae

Specimen examined: On living leaves of *Jasminum malabaricum* Wight. (Oleaceae), Chandoli National Park, Maharashtra, India, 12.02.2015, Holotype, RD, 201731 BSI (WC).

Diagnostic features: *A. jasmini* Hansf. is distinct from other species of *Asterina* (known in the family Oleaceae) in having unicellular appressoria. The *A. jasmini* var. *koyani* differs from other species of *A. viz. A. jasmini* var. *indica* and *A. jasmini* var. *jasmini*. It has highly dissolved thyriothechia and echinulate ascospores. Therefore, it is justified to assign it as a new variety.

Notes: No species of *Asterina* and *Asterostomella* have been reported on *J. malabaricum* from India.

Remarks: Thus, this is the first report on the association of *A. jasmini* and its pycnothyrial stage (*Asterostomella*) with *J. malabaricum* from India and *A. jasmini* Hansf. var. *koyani* is a new variety for science.

Asterina jasminicola Yates, *Philippine J. Sci.* 13: 373 1918; Maity, *Indian J. Mycol. Res.* 16: 24 1978. Figure 12

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Dothideomycetidae, Asterinales, Asterinaceae.

Specimens examined: On the leaves of *Jasminum multiflorum* (Burm. f.) Andrews (Oleaceae), Kudal,

Sawantwadi, Sindhudurg Dist., Maharashtra, India, 20.01.2012, RD, 200080 BSI (WC).

Known distribution: The fungus has been reported earlier on leaves of *Jasminum pubescens* Willd (Oleaceae), West Bengal, Howrah, and Panchla (Maity 1978).

Remarks: This is a new record of the fungus in Maharashtra.

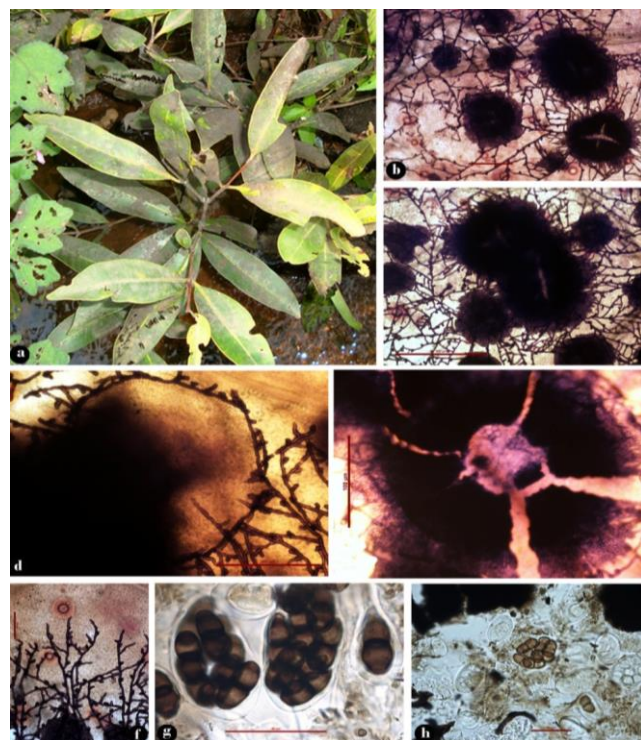


Figure 10. *Asterina jambolanae* (a) Black mildews of *Eugenia* sp. (b-c) Appressariate mycelia with thyriothechia (d) young thyriothechia (e) Dehiscent thyriothechia with ascospores (f) Mycelial Appressoria (g-h) Asci & ascospores. [Bar : (b-d) = 200 μ m, (e-f) = 100 μ m, (g-h) = 50 μ m.]

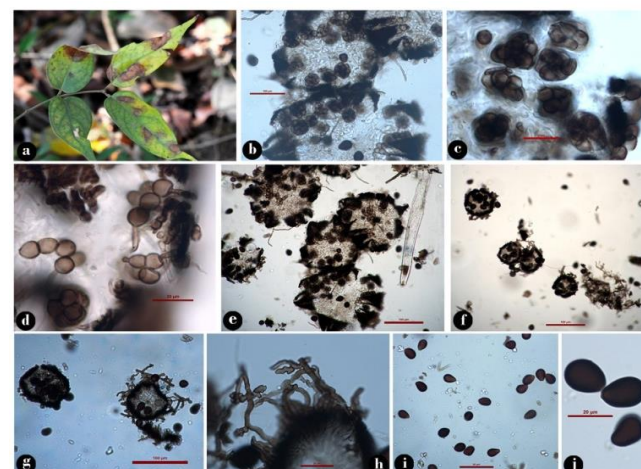


Figure 11. *Asterina jasmini* var. *koyani* var. nov. (a) Infected leaves of *Jasminum malabaricum* (b) Highly dissolved thyriothechia with asci (c) Asci (d) Echinulate ascospores (e-g) pycnothyria with pycnothyriospores (h) Bifid and deeply lobate unicelled appressoria (i-j) pycnothyriospores. [Bar : (b, e-g) = 100 μ m, i = 50 μ m, (c, d, h, j) = 20 μ m.]

Asterina morellae Hosag., CK Biju & Abraham, *Indian Phytopath.* 54: 137 2001; Hosag., *Zoos' Print J.*, 21: 2328 2006; Hosag., Chandraprabha & Agarwal, *Asterinales of Kerala*, p. 123 2011. Figure 13

Specimen examined: On the leaves of *Garcinia* sp. (Guttiferae), Location 2, Kusapur, Koyna WLS, Satara Dist., Maharashtra, India, 13.02.2015, RD, 201773 BSI (WC).

Known distribution: Earlier reported on living leaves of *Garcinia morella* from Thiruvananthapuram and Chemunji, Kerala (Hosagoudar 2012). There is a report of the occurrence of other species of *Asterina* viz. *A. garciniae* Hansf. and *A. garciniicola* Ouyang & Song on *Garcinia* from India and China (Hosagoudar 2012).

Asterina woodfordiae V.P. Sahni *Mycopath. Mycol. appl.* 23 (4): 330 1964. Figure 14

Specimen examined: On the leaves of *Woodfordia fruticosa* (L.) Kurz. (Lythraceae), on the way to Dahanu, Thane Dist., Maharashtra, India, 17.10.2012, RD, 201106 BSI (WC).

Known distribution: On leaves of *Woodfordia floribunda* from Radhanagri, Maharashtra (Thite and Kulkarni 1975) and on leaves of *W. fruticosa*, Jabalpur, MP (Sahni 1964)

Remarks: The fungus is reported after 40 years in Maharashtra state.

Asterina wrightiae Syd. *Annls mycol.* 29 (3/4): 236 1931. Figure 15

Specimen examined: On the leaves of *Lagerstroemia* sp. (Lythraceae), Khandala, Pune Dist., Maharashtra, India, 26.09.2011, RD, 199560 BSI (WC).

Known distribution: Earlier reported on *Wrightia lanatus* (Sydow and Petrak 1931) from the Philippines. It has also been reported from various places in Kerala, India (Hosagoudar 2012).

Remarks: *Lagerstroemia* sp. forms a new host record for *A. wrightiae*.

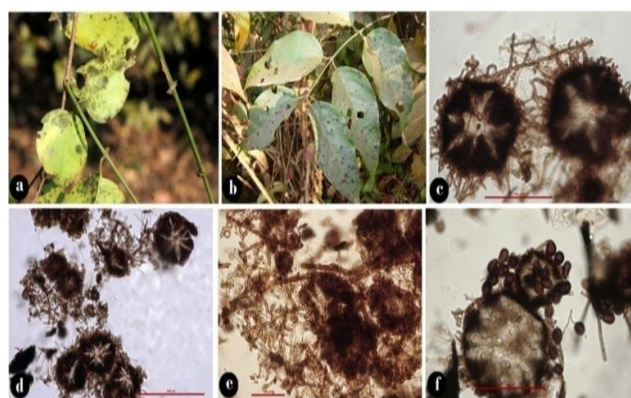


Figure 12. *Asterina jasminicola* – Black mildews of: (a) *Jasminum* sp. (b) *Jasminum multiflorum* (c) Thyriothecia with ascospores (d-e) Appresoriate mycelia with thyriothecia (f) Pycnothyria with pycnothyriospores. [Scale bar : e = 50 µm, d = 200 µm, (c,f) = 100 µm.]

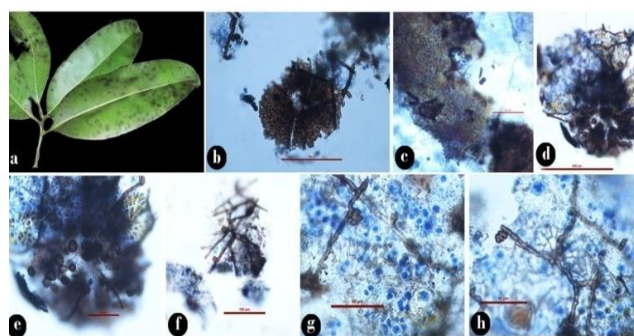


Figure 13. *Asterina morellae* (a) Black mildew of *Garcinia* sp. (b) Appresoriate mycelia with thyriothecia (c) Ascospores (d-e) Pycnothyria with pycnothyriospores (f-h) Sublobate to lobate appressoria. [Scale bars : (b, f) = 100 µm; (c, e, g, h) = 50 µm; d = 200 µm]

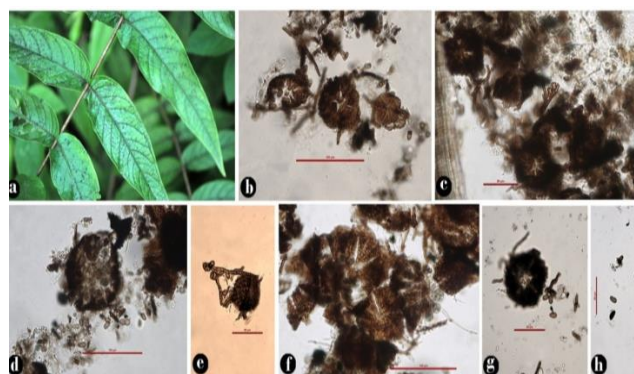


Figure 14. *Asterina woodfordiae* (a) Infected leaves of *Woodfordia fruticosa* (b-e) Appresoriate mycelia with thyriothecia (f) Thyriothecia with ascospores (g) Pycnothyria with pycnothyriospores (h) Pycnothyriospores. [Scale bars : (b, d, f) = 100 µm; (c, e, g, h) = 50 µm]

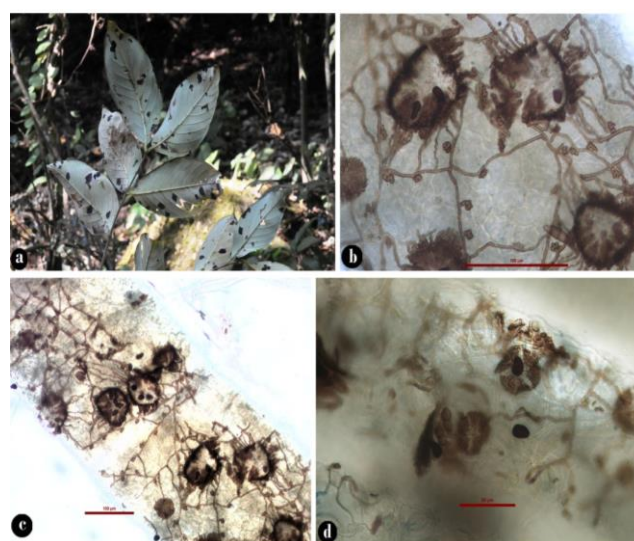


Figure 15. *Asterina wrightiae* (a) Black mildews of *Lagerstroemia* sp. (b-c) Appresoriate mycelia with thyriothecia and pycnothyria (d) Pycnothyria with pyriform pycnothyriospores. [Scale bars : (b, c) = 100 µm; d = 50 µm]

Asterina wrightii Berk. & M.A. Curtis, *Grevillea* 4 (29): 10 (1875). Figure 16

Specimen examined: On the leaves of *Paramignya monophylla* Wight, Forest Range, Dapoli, Ratnagiri Dist, Maharashtra, India, 26.01.2013, RD, 194051 BSI (WC).

Notes: Frequently reported on *Cucurbits*.

Remarks: It is a new record of fungal species from India.

Asterostomella state of *Asterina jasmini* Hansf. Figure 17

Specimen examined: On the leaves of *Jasminum* sp. (Oleaceae), Location 1, Chandoli National Park, Sangli Dist., Maharashtra, India, 11.02.2015, RD, 201688 BSI (WC).

Remarks: This is the first report of the occurrence of the *Asterostomella* state of *A. jasmini* on *Jasminum* sp. from India.

Asterostomella state of *Asterina jasminicola* Yates. Figure 18

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Dothideomycetidae, Asterinales, Asterinaceae.

Specimen examined: On the leaves of *Jasminum* sp. (Oleaceae), Location 3, Chandoli National Park, Sangli Dist., Maharashtra, India, 11.02.2015, RD, 201708 BSI (WC).

Remarks: This is the first report of the occurrence of the *Asterostomella* state of *A. jasminicola* from India.

Asterostomula pavettae V.B. Hosagoudar & A. Sabeena, *Mycosphere* 2 (5): 837 2007. Figure 19

Fungi, Ascomycota, Pezizomycotina, Incertae sedis, Incertae sedis, Incertae sedis, Incertae sedis.

Specimen examined: On the leaves of *Pavetta* sp., Location 2, Kusapur, Koyna WLS, Satara Dist., Maharashtra, India, 13.02.2015, RD, 201776 BSI (WC).

Known distribution: on the leaves of *Pavetta tomentosa* Roxb. ex Smith (Rubiaceae), Kerala (Hosagoudar and Sabeena 2007).

Remarks: This is the first record of the fungus in Maharashtra.

Balladyna pavettae Boedijn, *Persoonia* 1 (4): 398 1961. Figure 20

Specimen examined: On the leaves of –

Synedrella nodiflora (L.) Gaertn. (Asteraceae), Akeri, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 20.01.2012, RD, 200026 BSI (WC).

Pavetta crassicaulis Bremek (Rubiaceae), Old Mahabaleshwar, Satara Dist., Maharashtra, India, 24.01.2012, RD, 200326 BSI (WC).

Known distribution: There is no report of the occurrence of *B. pavettae* from India. There is a report of the occurrence of fungus on the leaves of *Pavetta gardeniaefolia* from Java (Boedijn 1961).

Remarks: This is a new record of the fungal species in India.

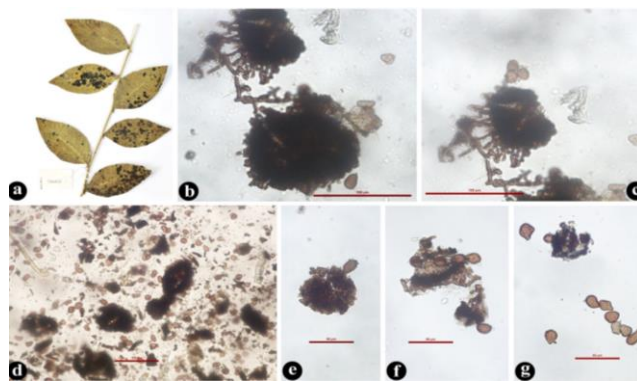


Figure 16. *Asterina wrightii* (a) Black mildews of *Paramignya monophylla* (b) Thyrothecia (c-e) Appresoriata pycnothyria with pycnothyriospores (f-g) Pycnothyriospores. [Scale bar : (b-d) = 100 µm; (e-g) = 50 µm]

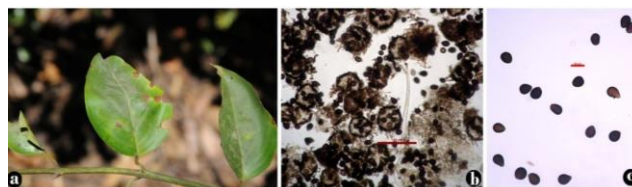


Figure 17. *Asterostomella* state of *Asterina jasmini* (a) Black mildew of *Jasminum* sp. (b) Pycnothyria (c) Pycnidiospores. [Scale bars: b = 100 µm; c = 50 µm]

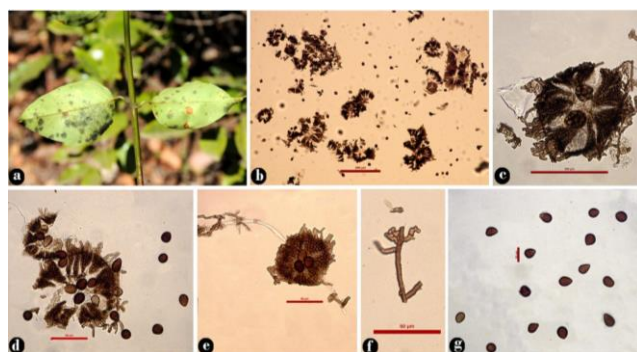


Figure 18. *Asterostomella* state of *Asterina jasminicola* (a) Black mildew of *Jasminum* sp. (b) Colony (c) Dehiscent with ascus and ascospores (d) Dehiscent Pycnothyria (e) Pycnothyria (f) Bicelled appressoria (g) Pycnothyriospores. [Scale Bar : b = 200 µm; c = 100 µm; (d-f) = 50 µm; g = 20 µm]

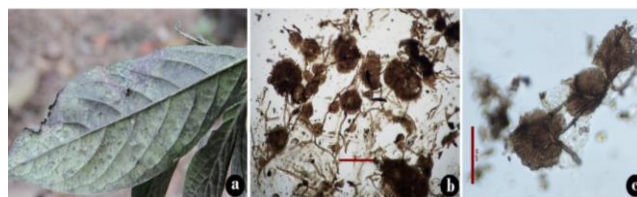


Figure 19. *Asterostomula pavettae* (a) Black mildews of *Pavetta* sp. (b) Mycelium with Pycnothyria (c) Pycnothyria with pycnothyriospores. [Scale bars: b = 100 µm; c = 50 µm]

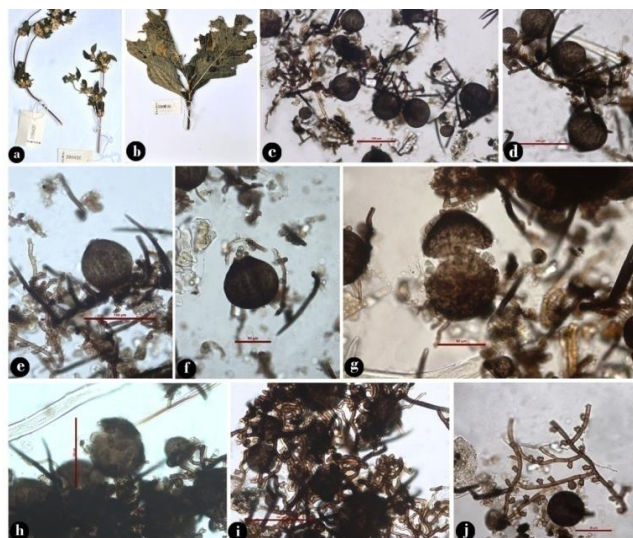


Figure 20. *Balladyna pavettae* - Black mildews of. (a) *Synedrella nodiflora* (b) *Pavetta crassicaulis* (c-d) Appresoriate mycelia with perithecia and setae (e-i) Perithecia with asci (j) mycelial appressoria. [Scale bar: (c-e), h,i = 100 µm; f,g,j = 50 µm]

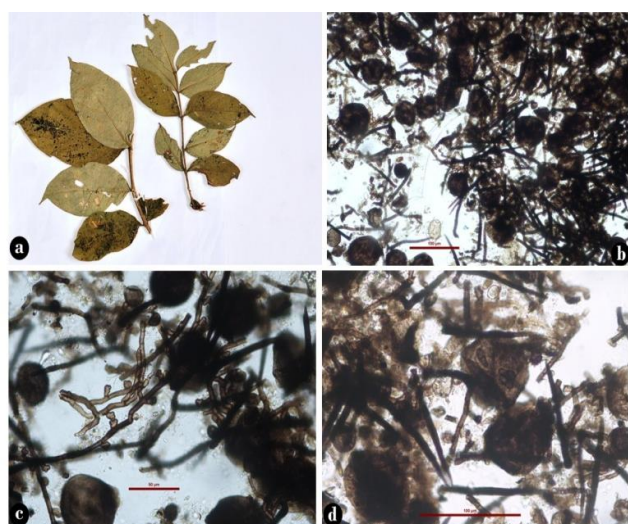


Figure 21. *Balladyna ugandensis* (a) Black mildews of *Pavetta* sp. (b-c) Appresoriate mycelia with Perithecia (d) Mature perithecia with asci and ascospores. [Scale bar: b, d = 100 µm; c = 50 µm]

Balladyna ugandensis Syd. & P. Syd. *Annls mycol.* 37 (3): 202 1939. Figure 21

Specimen examined: On the leaves of *Pavetta* sp. (Rubiaceae), Teragaon, Bhimashankar, WLS, Pune Dist. Maharashtra, India, 28.09.2011, RD, 199628 BSI (WC).

Remarks: This is a new host record from India.

Balladyna vanderystii (Hansf.) Arx in Müller & von Arx, *Arx Beitr. Kryptfl. Schweiz* 11 (no. 2): 186 1962. Figure 22 *Balladynopsis vanderystii* Hansf. 1957.

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Incertae sedis, Incertae sedis, Balladynaceae

Specimen examined: On the leaves of *Catunaregam spinosa* (Thunb.) Tirveng. (Rubiaceae), Kodawali-Rajapura, Ratnagiri, Maharashtra, India, 24.01.2013, RD, 200993 BSI (WC).

Known distribution: Earlier, the fungus was reported along with its teleomorphic and anamorphic stage (*Tretospora*) on living leaves of *Ixora* sp. from Baharaich. U.P. (Jamaluddin et al. 2004).

Notes: The species was previously named *Balladyniopsis vanderystii* Hansf. As per the species fungorum, 2016 (CABI database), the current name of the fungus is *B. vanderystii*.

Remarks: This is the first record of the fungus in the Maharashtra region of the Western Ghats and a new host record from India.

Balladyna velutina (Berk. & M.A. Curtis) Hohn Sber. *Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1* 119: 411 1910.

Figure 23 = *Asterina velutina* Berk. & M.A. Curtis, *Proc. Amer. Acad. Arts & Sci.* 4: 128 1860.

Specimen examined: On the leaves of *Pavetta indica* L. (Rubiaceae), Location 2, Koyna WLS, Maharashtra, India, 13.02.2015, RD, 201769 BSI (WC).

Known distribution: This is one of the most common species in the Western Ghats region. Previously it was reported on living leaves of *P. indica*, Radhanagari (Patil and Thite 1977); Panhala (Thite and Kulkarni 1973, 1976). On leaves of *Psychotria nilgiriensis* Deb & M.G.Gangop., Kuthiraiyar, Kodaikanal, 2007, R. Nithyatharani; Periyakanal, shola forest, Kodaikanal, 2008, R. Nithyatharani (Hosagoudar 2012).

Remarks: This is reported from Satara Dist. of Maharashtra for the first time.

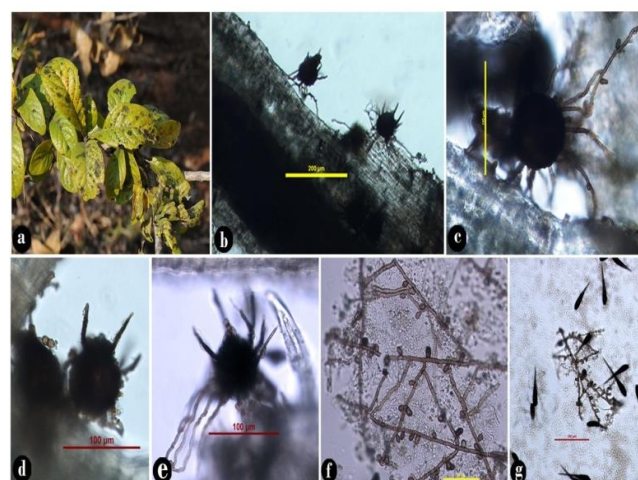


Figure 22. *Balladyna vanderystii* (a) Black mildews of *Catunaregam spinosa* (b-c) Appresoriate Perithecia (d-e) Perithecia with ascospores (f) Appressoria (g) Anamorphic state – *Tretospora* [Scale Bar: b = 200 µm; (c-e), g = 100 µm; f = 50 µm.]

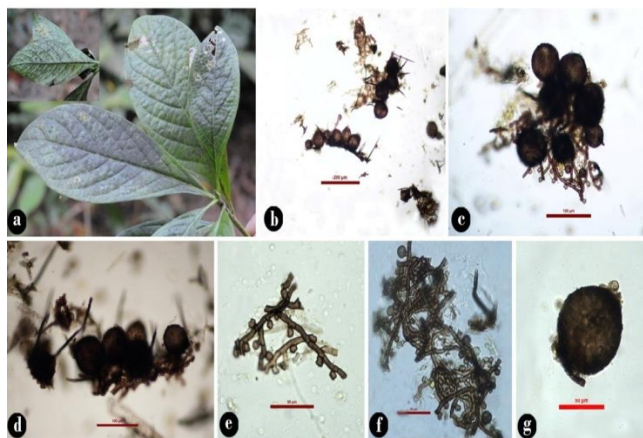


Figure 23. *Balladyna velutina* (a) Black mildews of *Pavetta indica* (b-d) Appresoriate mycelia with perithecia and setae (e) Appresoria (f) young perithecia (g) Mature perithecia with ascospores

Cirsosia vateriae Hosag., *Mycosphere* 2 (5): 799 2012.

Figure 24

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Dothideomycetidae, Asterinales, Asterinaceae.

Specimen examined: On the leaves of Unidentified plant species no. 4, Matheran, Maharashtra, India, 27.09.2011, RD, 199600 BSI (WC).

Known distribution: Worldwide, 15 species of *Cirsosia* have been reported. Nationwide the known distribution of *Cirsosia* is as *Cirsosia globulifera* (Pat.) Arx is reported on *Calamus* sp. from TBGRI, Trivandrum, Kerala (Hosagoudar 1996), Kollam, Kerala (Hosagoudar 2003), and *C. arecacearum*. Hosagoudar and Pillai reported on *Calamus thwaitesii* Deb & M.G.Gangop. from Karnataka (Hosagoudar and Pillai 1993); *C. globulifera* is reported on leaves on *Calamus pseudotenuis* Becc. from Karnataka (Hosagoudar and Pillai 1993).

Remarks: This is the first record of the fungus in the Maharashtra region of the Western Ghats.

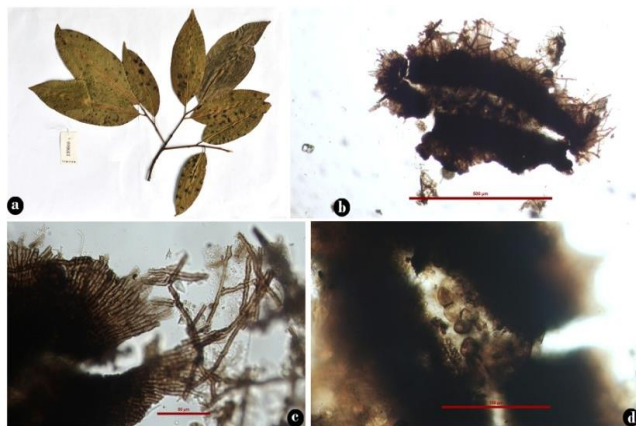


Figure 24. *Cirsosia vateriae* (a) On the leaves of Unidentified plant species (b) Longitudinally dehiscent thyrothecia (c) Fimbriate margin of thyrothecia (d) Ascospores [Scale bar: b = 500 µm; c = 50 µm; d=100µm]

Meliola agrostistachydis Hosag & Rajkumar J. *Mycopathol. Res.* 43 (1): 20 2005. Figure 25

Fungi, Ascomycota, Pezizomycotina Sordariomycetes, Incertae sedis, Meliolales, Meliolaceae

Specimen examined: On the leaves of *Agrostistachys borneensis* Becc. (Euphorbiaceae). Location 1, Metindoli, Koyna WLS, Satara Dist., Satara Dist., Maharashtra, India, 13.02.2015, RD, 201745 BSI (WC).

Known distribution: India – Kerala (Hosagoudar 2008)

Remarks: This is the first record of the fungus in Maharashtra state.

Meliola allophyli-serrulati Hosag. & T.K. Abraham J.

Mycopathol. Res. 36 (2): 99 1998. Figure 26

Specimen examined: On the leaves of *Allophylus* sp. (Sapindaceae), Fanaswadi, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200143 BSI (WC).

Known distribution: On the leaves of *Allophylus serrulatus* Raddlk., Kerala (Hosagoudar 2008); On *Allophylus cobbe* (L.) Forsyth fil. from Kerala (Maheshwari et al. 2012).

Notes: This is the first record of the fungus in Maharashtra state.

Meliola alstoniae Koord Verh. K. Akad. Wet., tweede sect. 13 (4): 170 1907. Figure 27

Specimen examined: On the leaves of Unidentified plant sp. 8, Kesari, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200157 BSI (WC).

Known distribution: On the leaves of *Alstonia scholaris* (L.) R.Br. from Goa (Thite and Kulkarni 1978), Kerala, Karnataka, and Tamil Nadu (Maheshwari et al. 2012).

Remarks: This is the first record of the fungus in Maharashtra.

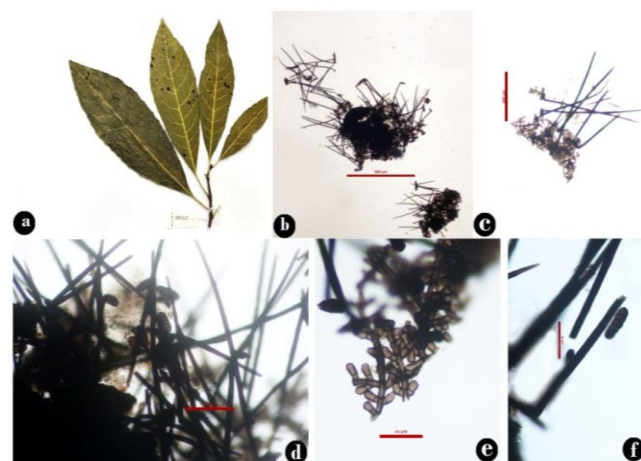


Figure 25. *Meliola agrostistachydis* (a) Black mildews of *Agrostistachys borneensis* (b) Perithecia with numerous setae (c) Perithecial setae (d) Setae with ascospores (e) Appresoria (f) Ascospores. [Scale bar: b = 500 µm; c = 200 µm; d = 100 µm; e, f = 50 µm.]

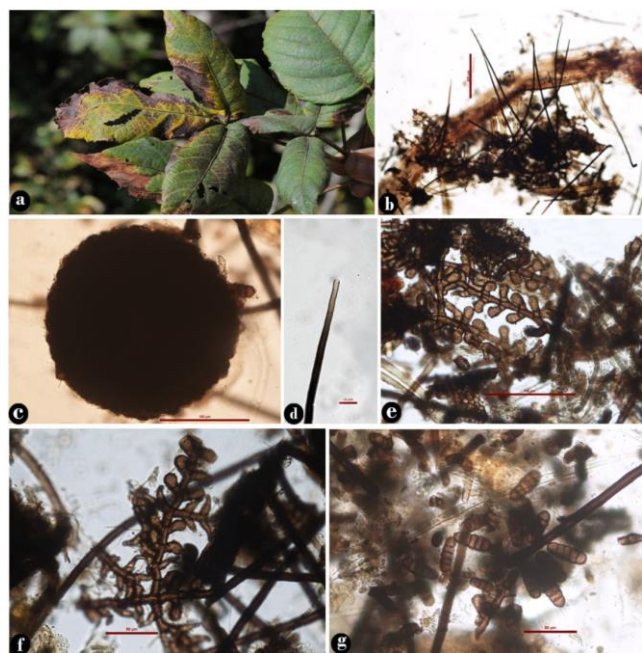


Figure 26. *Meliola allophyli-serrulati* (a) Black mildews of *Allophylus serrulatus* (b) Colonies (c) Perithecium (d) Apical portion of mycelial setae (e) Appresoria (f) Appresoria and phialides (g) Ascospores. [Scale bar: b = 200 µm; c, e = 100 µm; d = 20 µm; f, g = 50 µm.]

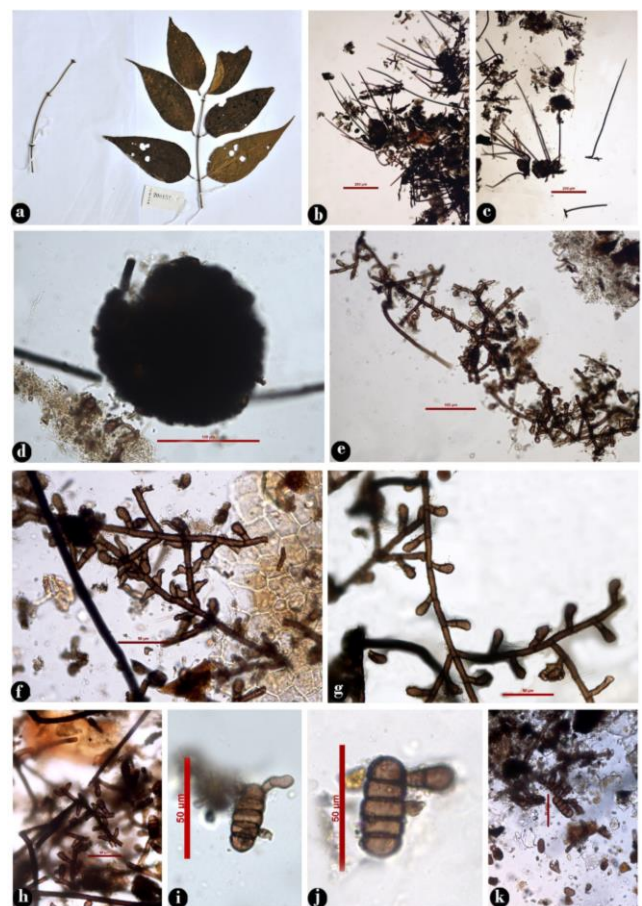


Figure 27. *Meliola alstoniae* (a) Black mildews of unidentified plant sp. (b-c) Colonies (d) Perithecium (e-h) Appresoria and phialides (i-k) Ascospores. [Scale bar: b, c = 200 µm; d, e = 100 µm; (f-k) = 50 µm.]

Meliola bauhiniicola W. Yamam., *Trans. Nat. Hist. Soc. Formosa* 31: 225 1941. Figure 28

Fungi, Ascomycota, Pezizomycotina Sordariomycetes, Incertae sedis, Meliolales, Meliolaceae

Specimen examined: On *Bauhinia* sp. (Leguminosae) leaves, Kurne-Lanje Tal. Reserved Forest, Ratnagiri Dist., Maharashtra, India, 24.01.2013, RD, 200988 BSI (WC).

Known distribution: On various species of *Bauhinia* from Andhra Pradesh, Kerala, Karnataka, and Maharashtra (Maheshwari et al. 2012).

Meliola buteae Hafiz Khan, Azmatullah & Kafi, *Biologia, Lahore* 1(1): 112 1955. Figure 29

Ascomycota, Pezizomycotina, Sordariomycetes, Incertae sedis, Meliolales, Meliolaceae

Specimen examined: On the leaves of *Butea monosperma* (Lam.) Taub. (Leguminosae), Sanjay Gandhi National Park, Maharashtra, India, 25.09.2013, RD, 196384 BSI (WC).

Known distribution: On the leaves of *B. monosperma*, Kerala (Hosagoudar 1996), and Maharashtra (Thite and Patil 1982-1983).

Meliola careyae (F. Stevens) Hosag., *Persoonia* 18 (2): 276 2003. Figure 30

Fungi, Ascomycota, Pezizomycotina Sordariomycetes, Incertae sedis, Meliolales, Meliolaceae

Specimen examined: On the leaves of *Careya arborea* Roxb. (Lecythidaceae), Akeri, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 20.01.2012, RD, 200022 BSI (WC).

Known distribution: On the leaves of *C. arborea* Roxb. from Karnataka (Hosagoudar 2008) and Kerala (Maheshwari et al. 2012).

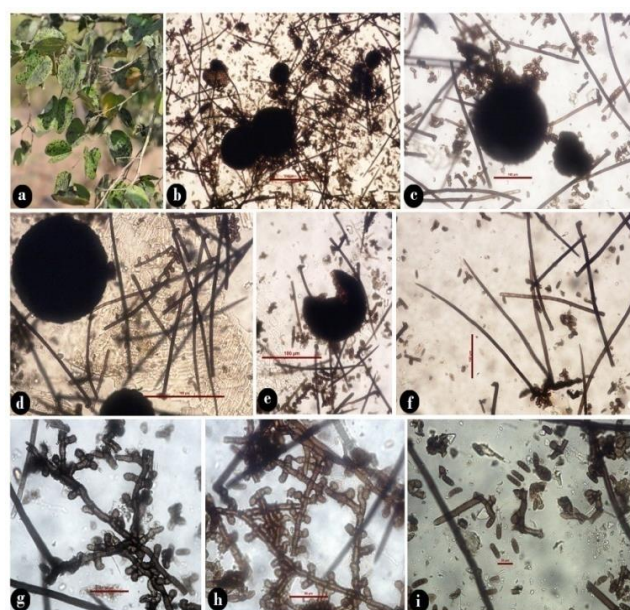


Figure 28. *Meliola bauhiniicola* (a) Black mildews of *Bauhinia racemosa* (b-e) Colonies with Perithecia (f) Setae (g-h) Appresoria and phialides (i) Ascospores. [Scale bar: b = 200 µm; (c-f) = 100 µm; g, h = 50 µm; i = 20 µm.]

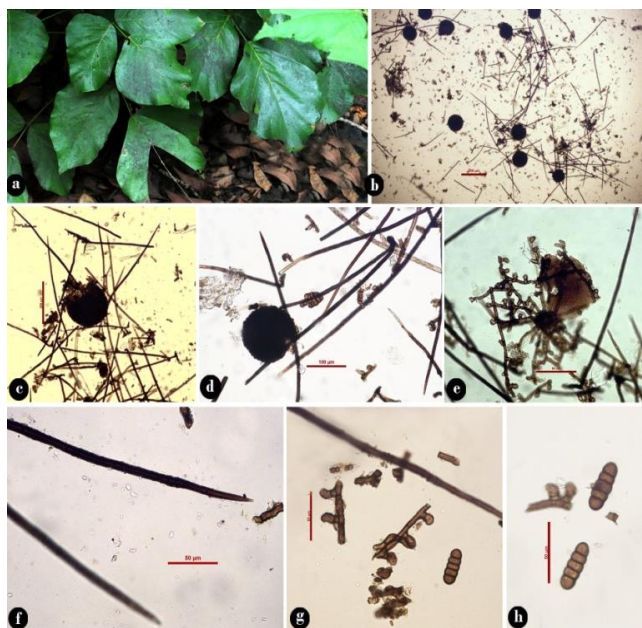


Figure 29. *Meliola buteae* (a) Black mildews of *Butea monosperma* (b) Colonies (c-d) Perithecia with setae and ascospores (e) Appresoria (f) Apical portion of mycelial setae (g) Phialides and Ascospores (h) Ascospores. [Scale bar: b,c = 200 µm; d = 100 µm; (e-h) = 50 µm.]

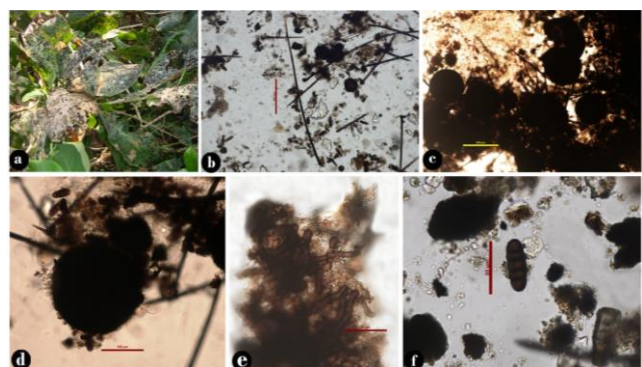


Figure 30. *Meliola careyae* (a) Black mildews of *Careya arborea* (b) Colonies (c-d) Perithecia (e) Appresoria and phialides (f) Ascospores. [Scale bar : b,c = 200 µm; d = 100 µm; (e-f) = 50 µm]

Meliola carissae var. *spinari* Hosag. *J. Econ. Taxon. Bot.* 13 (1): 31 1989. Figure 31

Specimen examined: On the leaves of *Carissa spinarum* L. (Apocynaceae), on the way to Jhap, Thane Dist., Maharashtra, India, 16.10.2012, RD, 201027 BSI (WC).

Known distribution: On leaves of *C. spinarum* (Apocynaceae), Uttar Pradesh, 1976, Kamal (Hosagoudar 1996); On leaves of *C. spinarum*, Coimbatore, Tamil Nadu (Hosagoudar 1989).

Remarks: This is the first record of the fungus in Maharashtra state.

Meliola desmodii-triquetri Hosag. & Manojk in Hosagoudar, *Zoos' Print Journal* 19 (5): 1464 2004. Figure 32.

Specimen examined: On the leaves of *Desmodium triflorum* (L.) DC. (Leguminosae), Akeri, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 20.01.2012, RD, 200010 BSI (WC).

Known distribution: On leaves of *Desmodium triquetrum* (L.) DC. (Fabaceae), from Kerala (Hosagoudar 2008) and Uttarakhand (Maheshwari et al. 2012).

Remarks: This is the first record of the fungus in Maharashtra state.

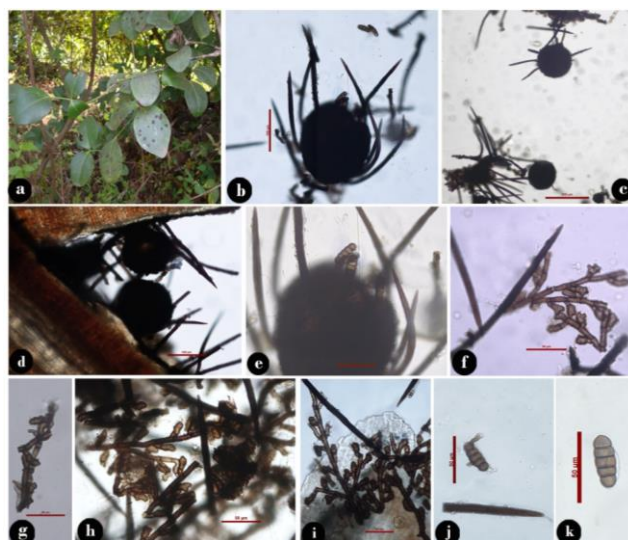


Figure 31. *Meliola carissae* var. *spinari* (a) Black mildews of *Carissa spinarum* (b-e) Perithecia with setae and ascospores (f-i) Appresoria and phialides (j-k) Ascospores. [Scale bar : b, d = 100 µm; c = 200 µm; (e-k) = 50 µm]



Figure 32. *Meliola desmodii-triquetri* (a) Black mildews of *Desmodium triflorum* (b,c) Perithecia with setae (d) Perithecial setae (e-f) Appresoria and ascospores (g) Apical portion of mycelial setae (h) Ascospores. [Scale bar: b, e, f, h = 50 µm; c, d = 100 µm; g = 20 µm.]

Meliola diospyri H.S. Yates Syd. & P. Syd., in Sydow, Sydow & Butler, *Annls mycol.* 9 (4): 381 1911. Figure 33

Specimen examined: On the leaves of *Diospyros* sp., (Ebenaceae), location 1, Dajipur WLS, Kolhapur District, Maharashtra, India, 09.02.2015, RD, 201629 BSI (WC).

Known distribution: On living leaves of *Diospyros* sp., Karnataka, Maharashtra (Patil and Thite 1978; Thite and Kukarni 1973).

Remarks: Recorded for the second time from the Western Ghats of Maharashtra after 40 years.

Meliola eugeniae-jamboloidis Hansf., *Reinwardtia* 3: 98 1954. Figure 34 = *Meliola eugeniae-jamboloidis* var. *amphigena* A.K. Kar & Maity, *Nytt Mag. Bot.* 17 (2): 87 1970.

Specimen examined: On the leaves of *C. spinarum* (Apocynaceae), Kudal, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200084 BSI (WC).

Known distribution: On leaves of *Syzygium munronii*, Sairandhri silent valley, Kerala (Hosagoudar 2008)

Remarks: This forms a new host record from India.

Meliola eugeniae-stocksii Hosag. 1996 Figure 35

Specimens examined: On the leaves of –

Ixora brachiata Roxb. (Rubiaceae), Amboli Ghat, Sindhudurg, Maharashtra, India, 22.01.2012, RD, 200178 BSI (WC).

Ficus sp. (Moraceae), Location 2, Radhanagari WLS, Kolhapur Dist., Maharashtra, India, 10.02.2015, RD, 201782 BSI (WC).

Ixora brachiata Roxb. (Rubiaceae), Fanaswadi, Sindhudurg, Maharashtra, India, 21.01.2012, RD, 200130 BSI (WC).

Remarks: This is the first record of the fungus in Maharashtra state.

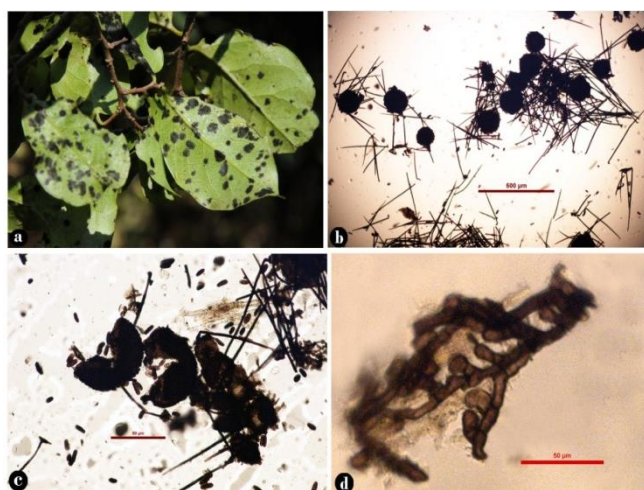


Figure 33. *Meliola diospyri* (a) Black mildews of *Diospyros* sp. (b) Colony (c) Perithecia with setae and ascospores (d) Mycelium with appressoria. [Scale bar : b = 500 µm; c, d = 50 µm.]

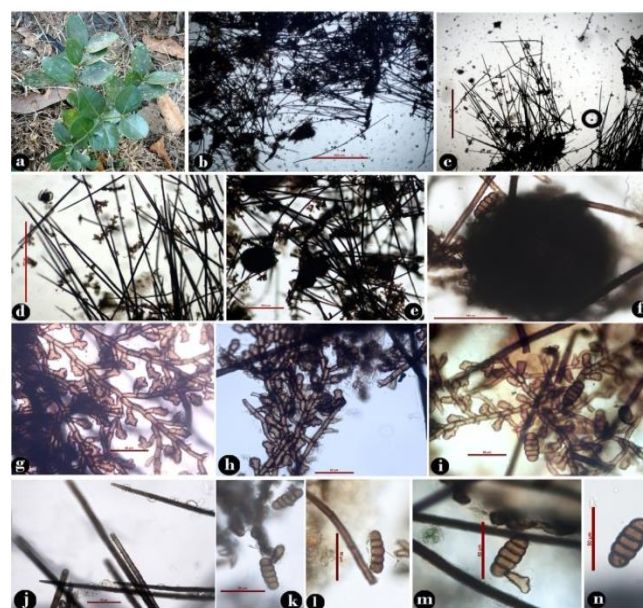


Figure 34. *Meliola eugeniae-jamboloidis* (a) Black mildews of *Eugenia* sp. (b-c) Colonies, (d-e) Perithecia with perithecial setae (f) Perithecium (g-i) Appresoria and phialides (j) Apical portion of mycelial setae (k-n) Ascospores. [Scale bar: (b-d) = 500 µm; e = 200 µm; f = 100 µm; (g-n) = 50 µm]



Figure 35. *Meliola eugeniae-stocksii* (a) Black mildews of *Ficus* sp. (b) Black mildews of *Ixora brachiata* (c) Perithecium with mycelia setae (d-e) Appresoria and phialides (f) Apical part of setae and phialides, (g) Ascospores. [Scale bar: c = 200 µm; d = 100 µm; (e-g) = 50 µm.]

Meliola flemingiicola Hosag., Jose & H. Biju in Hosag., *J. Mycopathol. Res.* 43:26, 2005. Figure 36

Specimen examined: On the leaves of *Lagerstroemia* sp. (Lythraceae), Pasarni Ghat, Satara Dist., Maharashtra, India, 25.01.2012, RD, 200371 BSI (WC).

Remarks: This is the first fungus record in Maharashtra and forms a new host record of fungi from India.

Meliola garhwalensis S.L. Srivast. & Topal, *Geophytology* 11 (2): 264 1981. Figure 37 = *Meliola rubi* var. *garhwalensis* (S.L. Srivast. & Topal) Hosag. & N.P. Balakr., in Hosagoudar, Patil & Balakrishnan, *J. Econ. Taxon. Bot.* 13 (1): 81 (1989).

Specimen examined: On the leaves of *J. malabaricum* Wight. (Oleaceae), Old Mahabaleshwar, Satara Dist., Maharashtra, India, 24.01.2012, RD, 200335 BSI (WC).

Remarks: It is a new record for Maharashtra state and a new host record.

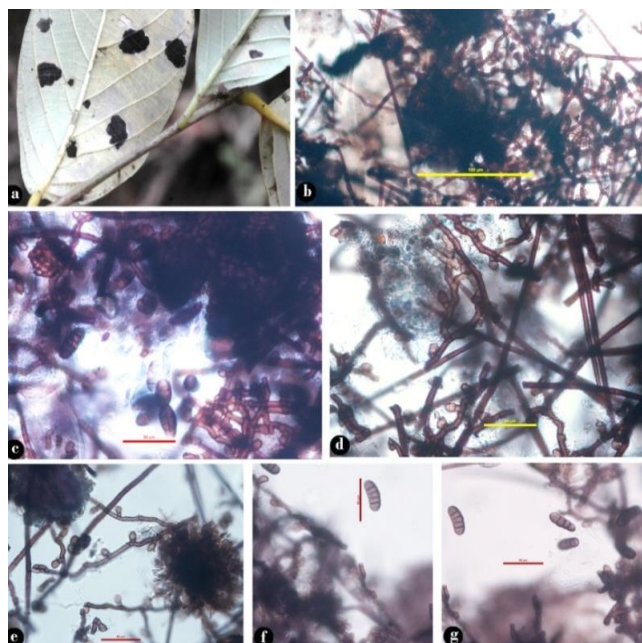


Figure 36. *Meliola flemingiicola* (a) Black mildews of *Lagerstroemia* sp. (b) Perithecia (c) Ascus with ascospores (d-e) Appresoria and phialides (f-g) Ascospores. [Scale bar: b = 100 µm, (c-g) = 50 µm.]

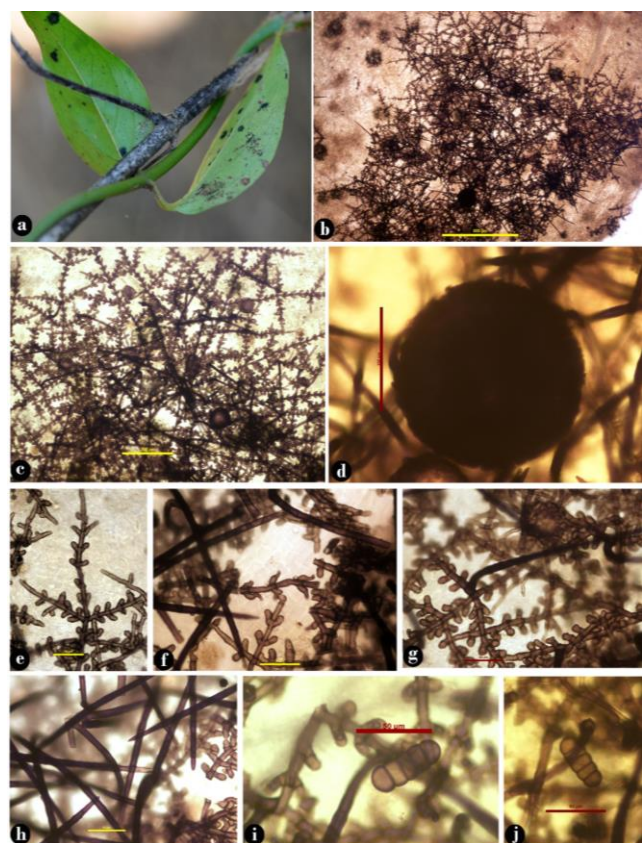


Figure 37. *Meliola garhwalensis* (a) Black mildews of *Jasminum malabaricum* (b-c) Colonies with opposite appressoria (d) Perithecium (e-g) Mycelium with setae appressoria and phialides (h) Mycelial setae (i-j) Ascospores. [Scale bar: b = 500 µm; c = 200 µm; d = 100 µm; (e-j) = 50 µm.]

Meliola hemidesmicola Hosag, *Meliolales of India* (Calcutta): 212 1996. Figure 38

Specimen examined: On *Periplocaceae* sp 2., Kesari, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200148 BSI (WC).

Known distribution: On leaves of *Hemidesmus indicus* (L.) from Kerala, Maharashtra, Tamil Nadu (Maheshwari et al. 2012).

Meliola holarrhenae Hansf. & Thirum., *Farlowia* 3: 294 1948. Figure 39

Specimen examined: On the leaves of *Holarrhena pubescens* (Buch. - Ham.) Wall. Ex DC. (Apocynaceae), Sanjay Gandhi National Park Maharashtra, India, 25.09.2013, RD, 196402 BSI (WC).

Known distribution: India- On leaves of *H. pubescens* from Karnataka and Kerala (Maheshwari et al. 2012).

Remarks: This is the first record of the fungus in Maharashtra state.

Meliola holigarnae F. Stevens, *Annls mycol.* 26(3/4): 260 1928. Figure 40

Specimen examined: On the leaves of *Holigarna* sp. (Anacardiaceae), Location 1, Metindoli, Koyna WLS, Satara Dist., Maharashtra, India, 13.02.2015, RD, 201754 BSI (WC).

Known distribution: On leaves of *Holigarna grahamii* (Wight) Kurz, Maharashtra (Thite and Kulkarni 1973); On leaves of *Holigarna* sp., Kerala, Karnataka, Tamil Nadu (in Maheshwari et al., 2012); On leaves of *Holigarna beddomei* Wall. ex Hook.fil., Karnataka; On leaves of *H. arnotiana*, Kerala; On leaves of *Holigarna* sp., Karnataka (Maheshwari et al. 2012).

Remarks: This is the second time reported from the Maharashtra state.

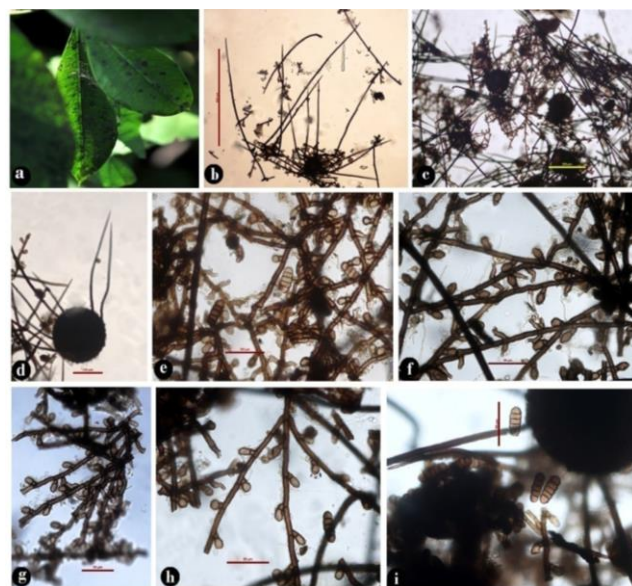


Figure 38. *Meliola hemidesmicola* (a) Black mildews of *Periplocaceae* sp. (b-c) Colonies (d) Perithecia (e-h) Appresoria and phialides (i) Ascospores. [Scale bar: b = 500 µm; c = 200 µm; d, e = 100 µm; (f-i) = 50 µm.]

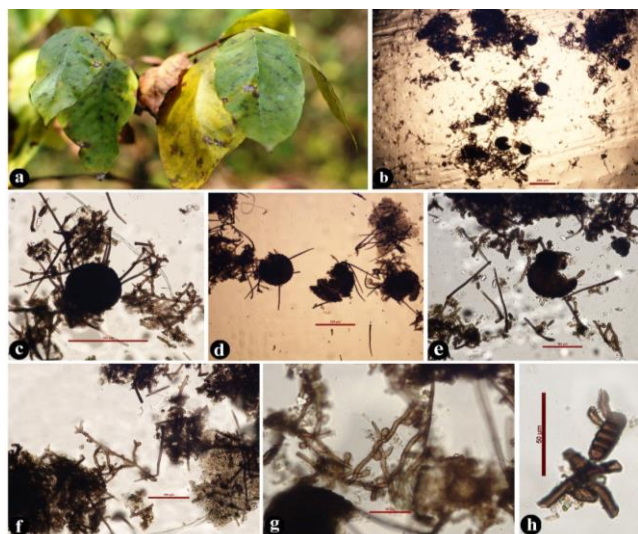


Figure 39. *Meliola holarrhenae* (a) Black mildews of *Holarrhena pubescens* (b) Colonies (c-e) Perithecia with mycelia setae and ascus (f-g) Appresoria and phialides (h) Ascospores. [Scale bar : (b-d) = 200 µm; e, f = 100 µm; g, h = 50 µm.]

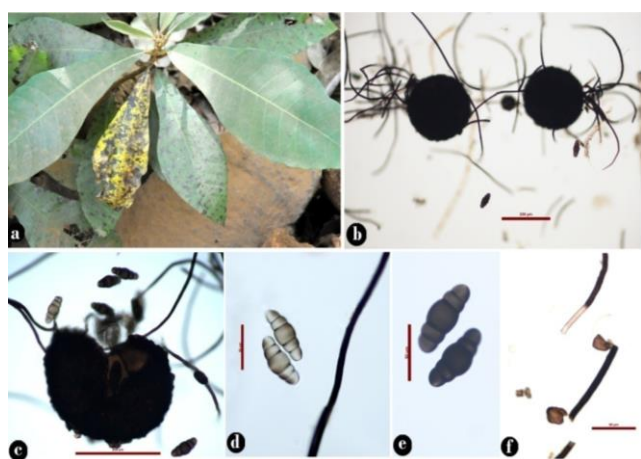


Figure 40. *Meliola holigarnae* (a) Black mildews of *Holigarna* sp. (b) Perithecia with mycelia setae (c) Perithecia with setae and ascospores (d-e) ascospores (f) Appresoria. [Scale bar : b, c = 200 µm; (d-f) = 50 µm]

Meliola hyptidis Syd. & P. Syd., *Annls mycol.* 8 (1): 36 1910. Figure 41

Specimen examined: On the leaves of –

Volkameria inermis L. (Lamiaceae), Kudal, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200085 BSI (WC).

Plectranthus sp., (Lamiaceae), Sanjay Gandhi National Park, Mumbai, Maharashtra, India, 25.09.2013, RD, 196393 BSI (WC).

Remarks: Both above hosts form new host records for *M. hyptidis* from India.

Meliola ixorae H.S. Yates, *Philipp. J. Sci., C, Bot.* 12: 365 1917. Figure 42

Specimen examined: On the leaves of *Ixora* sp. (Rubiaceae), Location 2, Radhanagari WLS, Kolhapur

Dist., Maharashtra, India, 10.02.2015, RD, 201662 BSI (WC).

Known distribution: Earlier reported on various species of *Ixora* from Kerala, Karnataka, and Maharashtra (Bilgrami et al. 1991; Maheshwari et al. 2012).

Meliola ixorae Yates var. *macrospora*, *Mycotaxon* 37: 235 1990. Figure 43

Specimen examined: On the leaves of –

Ixora brachiata Roxb. (Rubiaceae), on the way to Location 1, Amboli Ghat, Sindhudurg, Maharashtra, India, 22.01.2012, RD, 200215 BSI (WC).

Ixora brachiata Roxb. (Rubiaceae), Location 2, Amboli Ghat, Sindhudurg, Maharashtra, India, 22.01.2012, RD, 200180 BSI (WC).

Ixora coccinea L. (Rubiaceae), Kudal, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200077 BSI (WC).

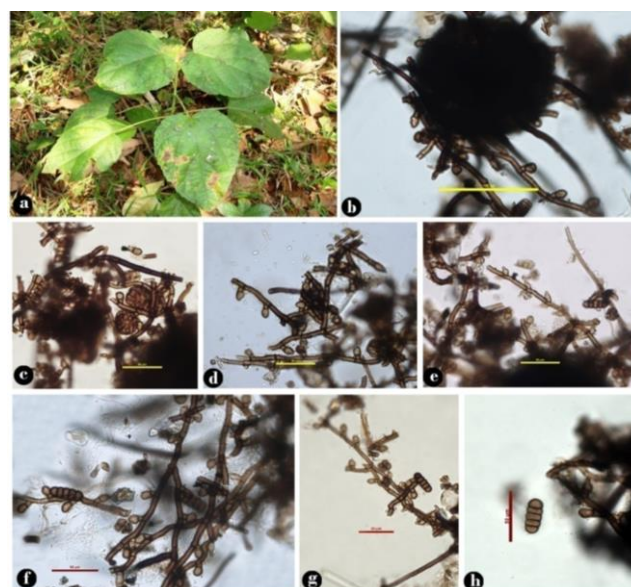


Figure 41. *Meliola hyptidis* (a) Black mildews of *Volkameria inermis* (b) Mature Perithecia (c) young Perithecia (d-e) Appresoria and phialides (f-g) Appresoria phialides & Ascospores (h) Ascospores. [Scale bar: b = 100 µm; (c-h) = 50 µm.]



Figure 42. *Meliola ixorae* (a) Black mildews of *Ixora* sp. (b) Colonies (c-d) Appresoria (e) Phialides (f) Ascospores. [Scale bar: b = 200 µm; (c-f) = 50 µm]

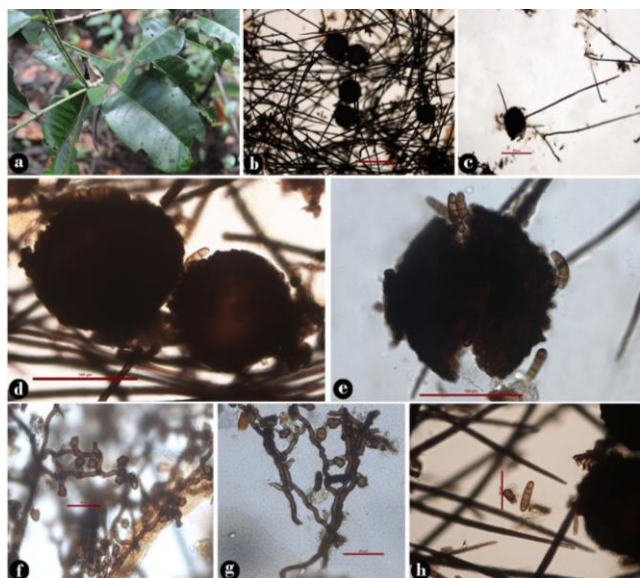


Figure 43. *Meliola ixorae* var. *macrospora* (a) Black mildews of *Ixora* sp. (b-c) Young perithecia (d-e) Mature perithecia with appressoria (f) Mycelial appressoria (g) Appressoria and phialides (h) Ascospores. [Scale bar: b, c = 200 µm; d, e = 100 µm; (f-h) = 50 µm]

Known distribution: On the leaves of *I. coccinea* (Rubiaceae) Radhanagari, Maharashtra, India, 1970, AN Thite (Hosagoudar 1996).

Remarks: *I. brachiata* forms a new host record from India.

Meliola ixorae-coccineae Hosag. & C.M. Pillai, in Hosagoudar, Raghu & Pillai, *Nova Hedwigia* 58 (3-4):539 1994. Figure 44

Specimen examined: On the leaves of –

Ixora brachiata Roxb. (Rubiaceae), Amboli Ghat, Sindhudurg, Maharashtra, India, 22.01.2012, RD, 200180 BSI (WC).

Ixora sp. (Rubiaceae), Location 1, Dajipur WLS, Kolhapur district, Maharashtra, India, 09.02.2015, RD, 201626 BSI (WC).

Known distribution: On leaves of *I. coccinea* (Rubiaceae), Kerala, 14 September 1992, C.M. Pillai (Hosagoudar 1996).

Remarks: This is a new host record for the fungus from India.

Meliola jasminicola Henn. *Hedwigia* 34: 11 1895. Figure 45

Specimens examined: On the leaves of –

Jasminum multiflorum (Burm. f.) Andrews (Oleaceae), Location 1, Kudal, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 20.01.2012, RD, 200080 BSI (WC).

Strychnos nux-vomica L. (Loganiaceae), Location 2, Kudal, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200083 BSI (WC).

Known distribution: On *Jasminum* sp. from Karnataka, Kerala, and West Bengal (Maheshwari et al. 2012)

Remarks: Both hosts mentioned above form a new host record from India.



Figure 44. *Meliola ixorae-coccineae* (a) Black mildews of *Ixora* sp. (b) Black mildews of *Ixora brachiata* (c) Perithecia with setae and ascospores (d) Mycelium with appressoria (e) Mycelial setae. [Scale bar : c = 100 µm; d, e = 50 µm]

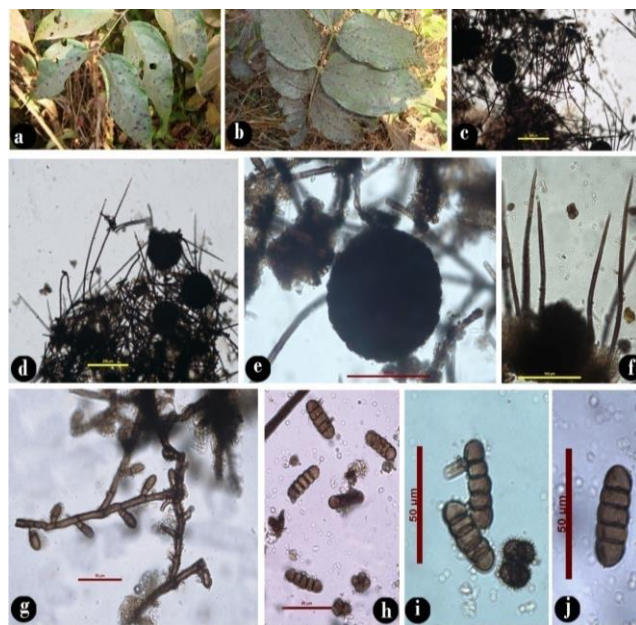


Figure 45. *Meliola jasminicola* (a) Black mildews of *Jasminum multiflorum* (b) Black mildews of *Strychnos nux-vomica* (c-d) Colonies (e) Perithecia (f) mycelia setae (g) Appressoria with phialides (h-j) Ascospores. [Scale bar: c, d = 200 µm; e, f = 100 µm; (g-j) = 50 µm.]

Meliola mangiferae Earle, *Bull. New York Bot. Gard.* 3: 307 1905 [1904]. Figure 46

Specimen examined: On the leaves of *Mangifera indica* L. (Anacardiaceae), On the way to Amboli Ghat, Sindhudurg Dist. Maharashtra, India, 22.01.2012, RD, 200219 BSI (WC).

Known distribution: On Leaves of *M. indica*, Karnataka, Kerala, South Andaman, Tamil Nadu (Hosagoudar 1996).

Remarks: This is the first record of the fungus in Maharashtra state.

Meliola melanoxylois Hosag. & C.M. Pillai, in Hosagoudar, Raghu & Pillai, *Nova Hedwigia* 58 (3-4): 540 1994. Figure 47

Specimens examined: On the leaves of

Acacia auriculiformis Benth. (Leguminosae), Kesari, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200146 BSI (WC).

Carissa spinarum L. syn. *Carissa congesta* Wight, (Apocynaceae), Kirbet, Ratnagiri Maharashtra, India, 23.01.2013, RD, 200935 BSI (WC).

Known distribution: On leaves of *A. auriculiformis* from Karnataka (Maheshwari et al. 2012).

Remarks: This is the first record of the fungus in Maharashtra state, and also, *C. spinarum* forms a new host record for *M. melanoxylois* from India.

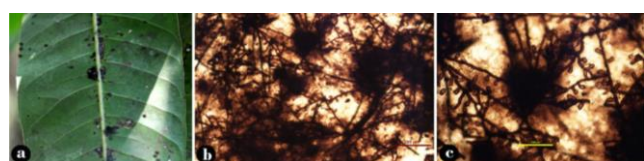


Figure 46. *Meliola mangiferae* (a) Black mildews of *Mangifera indica* (b-c) Colonies with perithecia, setae, appressoria, and phialides. [Scale bar: b = 200 µm; c = 100 µm.]



Figure 47. *Meliola melanoxylois* (a) Black mildews of *Acacia auriculiformis* (a) Black mildews of *Carissa congesta* (c-d) Perithecia with mycelial setae (e) Perithecia and appressoria (f) Young perithecia and appressoria (g-h) Appressoria and phialides (i-j) Apical part of setae (k) Ascospores. [Scale bar: c = 200 µm; d, e = 100 µm; (f-h), k = 50 µm; i, j = 20 µm.]

Meliola memecyli Syd. & P. Syd., *Annls mycol.* 15 (3/4): 189 1917. Figure 48

Specimen examined: On the leaves of *Memecylon umbellatum* Burm.f. (Melastomataceae), Location 2, Dajipur WLS, Kolhapur District, Maharashtra, India, 09.02.2015, RD, 201646 BSI (WC).

Known distribution: On leaves of *M. umbellatum* from Karnataka, Kerala, and Maharashtra.

Meliola memecylicola Hansf, *Sydowia* 10 (1-6): 78 1957. Figure 49

Specimen examined: On the leaves of *Memecylon talbotianum* Brandis (Melastomataceae), Location 1, Radhanagri WLS, Maharashtra, India, 23.01.2012, RD, 200277 BSI (WC).

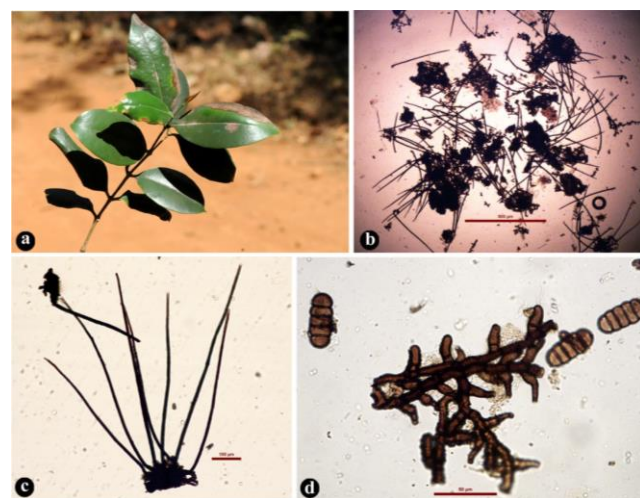


Figure 48. *Meliola memecyli* (a) Black mildew of *Memecylon umbellatum* (b) Colony (c) Mycelial setae (d) Ascospores. [Scale bar: b = 500 µm; c = 100 µm; d = 50 µm.]

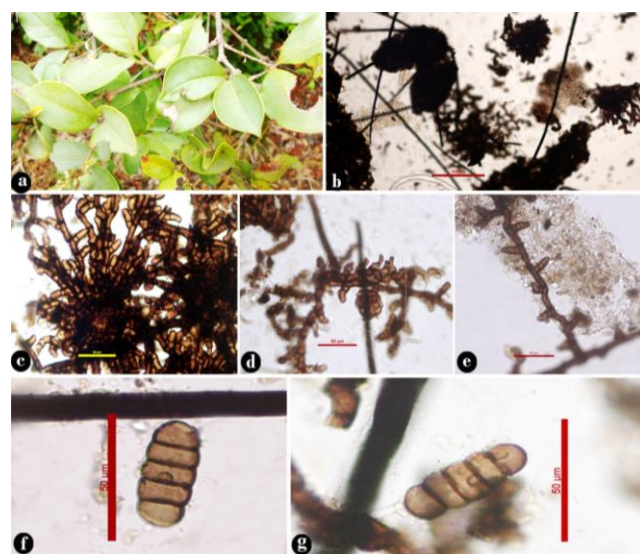


Figure 49. *Meliola memecylicola* (a) Black mildews of *Memecylon talbotianum* (b) Perithecia (c) appressoria (d-e) phialides (f-g) Ascospores. [Scale bar: b = 200 µm; c-g = 50 µm.]

Meliola mitragynae Syd. & P. Syd., *Philipp. J. Sci., C, Bot.* 8 (5): 478 1913. Figure 50

Specimen examined: On the leaves of *Mitragyna parvifolia* (Roxb.) Korth. (Rubiaceae), Sanjay Gandhi National Park, Maharashtra, India, 25.09.2013, RD, 196410 BSI (WC).

Known distribution: On living leaves of *M. parvifolia* from Karnataka and Uttar Pradesh (Hosagoudar 1996).

Remarks: This is a new record for Maharashtra state.

Meliola nothopegiae Hansf. 1957 Figure 51

Specimen examined: On the leaves of *Nothopegia* sp. (Anacardiaceae), Location 1, Dajipur WLS, Kolhapur District, Maharashtra, India, 09.02.2015, RD, 201606 BSI (WC).

Known distribution: Earlier reported on leaves of *Nothopegia* sp. from Mysore, Karnataka (Hansford 1956).

Remarks: This is the first report of the occurrence of fungus from Maharashtra.

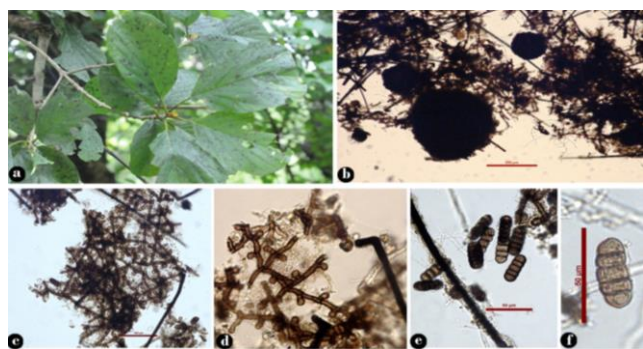


Figure 50. *Meliola mitragynae* (a) Black mildews of *Mitragyna parvifolia* (b) Perithecia (c-d) appressoria and phialides (e-f) ascospores. [Scale bar : b = 200 µm; c = 100 µm; e, f = 50 µm.]

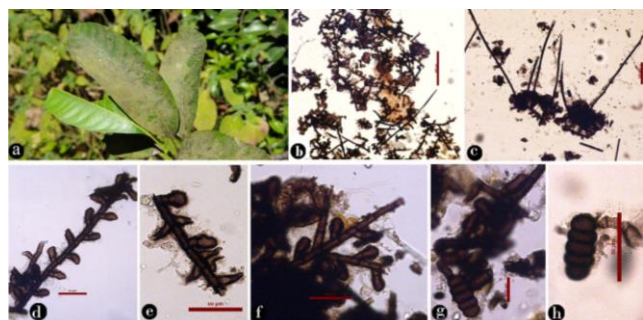


Figure 51. *Meliola nothopegiae* (a) Black mildews of *Nothopegia* sp., (b) Colonies with perithecia, (c) Perithecia with mycelial setae, (d-f) Mycelia with appressoria & phialides, (g-h) Ascospores [Scale Bar: b, f = 200 µm; c, g = 100 µm; d, e, h = 50 µm.]

Meliola pandanacearum Hosag. & T.K. Abraham, *Indian Phytopath.* 51 (3): 303 1999. Figure 52

Specimen examined: On the leaves of *Pandanus tectorius* Parkinson ex Du Roi (Pandanaceae), Fanaswadi, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200140 BSI (WC).

Known distribution: On *Pandanus odoratissima*, TGBRI, Thiruvananthapuram, Kerla (Hosagoudar and Abraham 1997)

Remarks: This is a new record of the fungus for Maharashtra.

Meliola pongamiae Hosag. & T.K. Abraham, *Nova Hedwigia* 68 (3-4): 483 1999. Figure 53

Specimen examined: On the leaves of *Pongamia pinnata* (L.) Pierre (Leguminosae), Kesari, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200163 BSI (WC).

Known distribution: On *P. pinnata* from Kerala and Tamilnadu (Hosagoudar 2008).

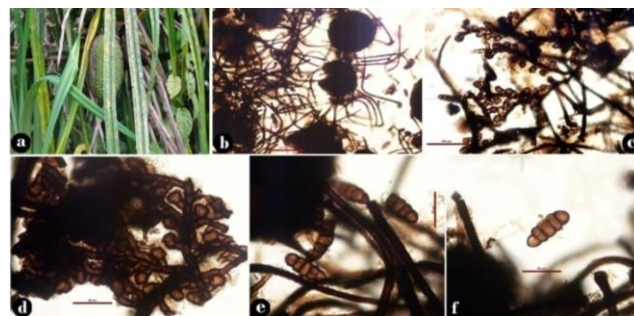


Figure 52. *Meliola pandanacearum* (a) Black mildews of *Pandanus tectorius* (b) Perithecia and mycelial setae (c-d) Mycelium with appressoria and phialides (e-f) Ascospores. [Scale bar: b = 200 µm; c = 100 µm; d-f = 50 µm.]



Figure 53. *Meliola pongamiae* (a) Black mildews of *Pongamia pinnata* (b-c) Perithecia and mycelia setae (d-e) Mycelium with appressoria and phialides (f) mycelial setae (g-h) Ascospores. [Scale bar : b = 200 µm; c = 100 µm; (d-h) = 50 µm.]

Meliola semecarpi-anacardii Hosag., Kaver., Raghu & Goos, *Mycotaxon* 51: 114 1994. Figure 54

Specimen examined: On the leaves of *Semecarpus anacardium* L.f. (Anacardiaceae), Kesari, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200158 BSI (WC).

Known distribution: It was reported on leaves of *S. anacardium* from Kerala, Karnataka, and Tamil Nadu (Bilgrami et al. 1991; Hosagoudar 1994).

Remarks: This is a new record of fungus for Maharashtra.

Meliola sp. Figure 55

Specimen examined: On leaves of *Casearia* sp. (Salicaceae), Location 1, Koyna WLS, Satara Dist.,

Maharashtra, India, 13.02.2015, RD, 201744 BSI (WC).

Remarks: Review of the literature reveals that no species of *Meliola* has been reported on *Caesaria* sp. Thus it forms a new host record from India.



Figure 54. *Meliola semecarpi-anacardii* (a) Black mildews of *Semecarpus anacardium* (b-c) Perithecia and mycelial setae (d-e) Mycelium with appressoria and phialides (f-g) Setae with ascospores (h) Ascospores. [Scale bar: b, c = 200 µm; (d-h) = 50 µm.]

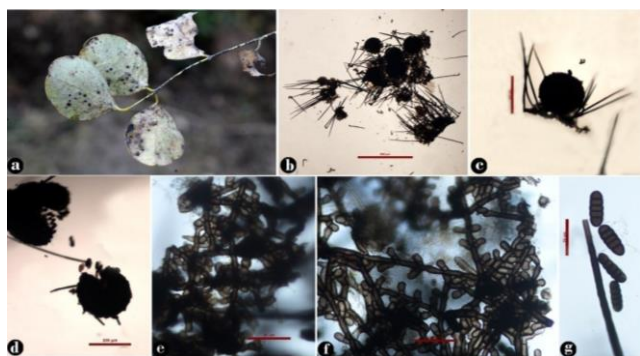


Figure 55. *Meliola* sp. (a) Black mildews of *Casearia* sp. (b-c) Perithecia and mycelial setae (d-f) Perithecia with ascospores (g-h) Mycelium with appressoria and phialides (i) Setae and

ascospores. [Scale bar : b = 500 µm; c, d = 200 µm; (e-g) = 20 µm]

Meliola tylophorae Hosag., in Hosagoudar & Goos, *Mycotaxon* 37: 250 1990. Figure 56

Specimen examined: On the leaves of *Tylophora* sp. (Apocynaceae), Akeri, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 20.01.2012, RD, 200038 BSI (WC).

Known distribution: Earlier reported on leaves of *Tylophora indica* (Burm.f.) Merr. (Maheshwari et al. 2012) and on leaves of *Tylophora caparidifolia* Wight & Arn. from Kerala (Hosagoudar 1996).

Remarks: It is a new record of fungi for Maharashtra state.

Meliola tylophorae-indicae Hosag. & Manoj k., *Indian Phytopath.* 57 (4): 466 2004. Figure 57

Specimen examined: On the leaves of *T. indica* (Burm.f.) Merr. (Apocynaceae), Kesari, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200150 BSI (WC).

Known distribution: Earlier reported on leaves of *Tylophora indica* (Burm.fil.) Merr. from Kerala (Hosagoudar 2008).

Remarks: This is a new record of fungus for Maharashtra state.

Meliola unicola Hosag. & T.K. Abraham, *Kavaka* 24: 16 1997 [1996]. Figure 58

Specimen examined: On the leaves of *Diospyros* sp., Phansad WLS, Raigad, 28.09.2013, RD, 196477 BSI (WC).

Remarks: This is a new host record from India.

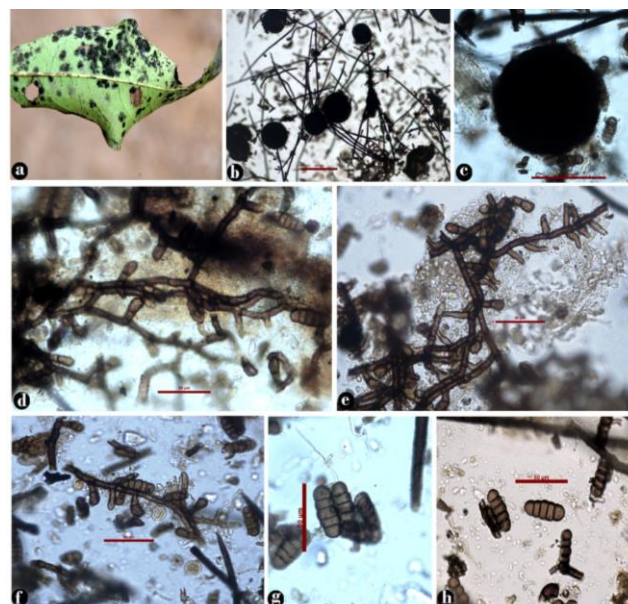


Figure 56. *Meliola tylophorae* (a) Black mildews of *Tylophora* sp. (b) Perithecia and mycelial setae (c) Perithecia (d-f) Mycelium with appressoria and phialides (g-h) Ascospores. [Scale bar: b = 200 µm; c = 100 µm; (d-h) = 50 µm.]

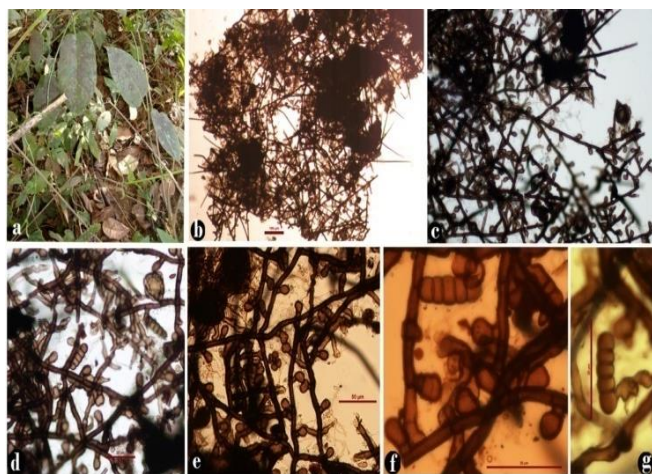


Figure 57. *Meliola tylophorae-indicae* (a) Black mildews of *Tylophora indica* (b-c) Colonies (d-e) Mycelial appressoria, phialides and ascospores (f-g) Ascospores. [Scale bar: b = 100 µm; (d-g) = 20 µm]

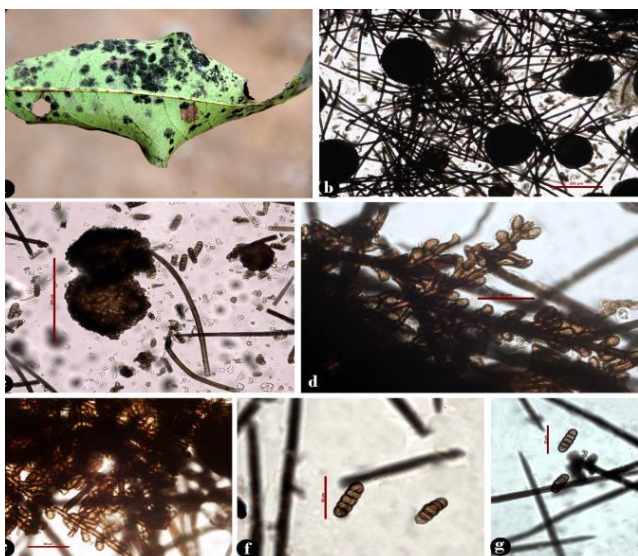


Figure 58. *Meliola unicola* (a) Black mildews of *Diospyros* sp. (b) Perithecia and mycelia setae (c) Perithecium with ascospores (d-e) Mycelium with appressoria (f-g) Ascospores. [Scale bar: b, c = 200 µm; (d-g) = 50 µm]

Meliola ziziphi Hansf. & Thirum., *Farlowia* 3 (3): 299 1948. Figure 59

Specimen examined: On the leaves of *Ziziphus jujuba* Mill. (Rhamnaceae), Fanaswadi, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200139 BSI (WC).

Known distribution: Earlier reported on leaves of *Z. rugosa*, Karnataka (Hansford and Thirumalchar 1948), Maharashtra. (Thite and Kulkarni 1973); on leaves of *Ziziphus* sp., Coimbatore (Hosagoudar 1996); On *Z. jujuba*, on *Z. oenoplia*, *Z. rugosa* and *Z. rugosa*, Kerala (in Maheshwari et al. 2012).

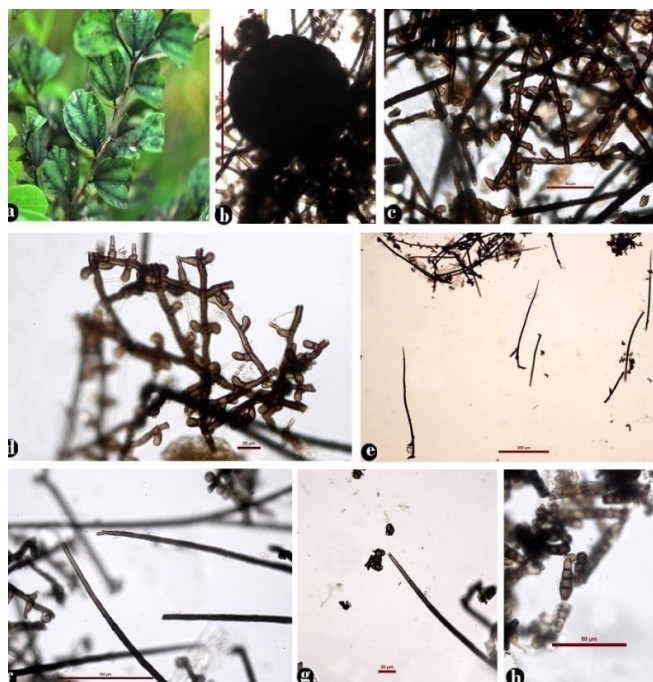


Figure 59. *Meliola ziziphi* (a) Black mildews of *Ziziphus rugosa* (b) Perithecium (c-d) Mycelium with appressoria and phialides (e-g) Setae (h) Ascospores. [Scale bar: b, e = 200 µm; c, h = 50 µm; d, g = 20 µm, f = 100 µm]

Meliolina mollis (Berk. & Broome) Höhn, Sber. Akad.

Wiss. Wien, Math.-naturw. Kl., Abt. 1128: 557 1919. Figure 60

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes Incertae sedis, Incertae sedis, Meliolinaeae.

Specimens examined: On the leaves of –

Leea indica (Burm. f.) Merr. (Vitaceae), Guest House, Kesari, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200117 BSI (WC).

Memecylon umbellatum Burm.f. (Melastomataceae), Kudal, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200089 BSI (WC);

Memecylon umbellatum Burm.f. (Melastomataceae), PWD Rest House, Mahabaleshwar, Satara Dist., Maharashtra, India, 24.01.2012, RD, 200289 BSI (WC);

Memecylon umbellatum Burm.f. (Melastomataceae), Old Mahabaleshwar, 24.01.2012, RD, 200329 BSI (WC).

Persicaria auriculata (Makino) Masam. Mahabaleshwar, Satara, Maharashtra, India, RD, 200314 BSI (WC).

Known distribution: On leaves of *Eugenia*, *Leptospermum*, and *Syzygium* (Burma, New Zealand, Srilanka, and India). It has been reported on leaves of *Syzygium montanum* from Nilgiris, Tamil Nadu (Pirozynski 1934); New Delhi (Ganju and Nair 1991); Coorg (Karnataka) and Silent Valley, Kerala (Hosagoudar 2008); Mahabaleshwar, Maharashtra (Anahosur 1969). There is a report of the occurrence of *M. memecylon* on the leaves of *M. umbellatum* Burm.f. (Melastomataceae) from Ambha ghat, Amboli ghat, Radhanagari, Petlon, Sangli, (Pandey 2008). A review of pertinent literature reveals that no species of *M. mollis* has not been reported on *M. umbellatum*, *L. indica*, and *P. auriculata*.

Remarks: This is a new host record from India.

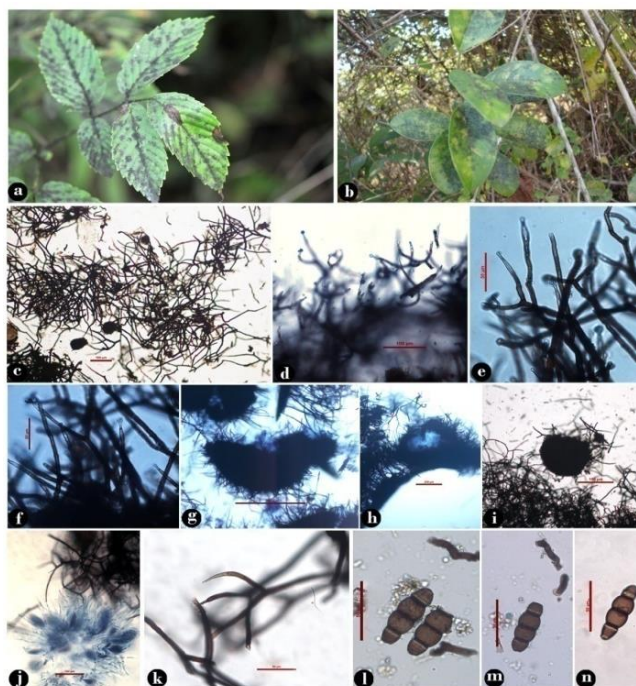


Figure 60. *Meliolina mollis* (a) Black mildews of *Leea indica* (b) Black mildews of *Memecylon umbellatum* (c) Colonies (d-f) Phialides and conidia (g-i) Pseudothecia covered with setae (j) Immature asci (k) Apical part of setae (l-n) Ascospores. [Scale Bar: c, f = 100 µm; d = 200 µm; (g-j) = 50 µm]

Mitteriella ziziphina Syd., *Annls mycol.* 31(1/2): 95 1933.

Figure 61

Fungi, Pezizomycotina, Dothideomycetes, Incertae sedis, Incertae sedis, Englerulaceae

Specimen examined: On the leaves of *Z. jujuba* Mill. (Rhamnaceae), Shikur, Thane Dist. Maharashtra, India, 16.10.2012, RD, 201036 BSI (WC).

Known distribution: Reported on leaves of *Z. Jujuba* from Uttar Pradesh. (Tandon 1935); *Z. nummularia*, Rajasthan (Berkeley 1882); *Ziziphus* sp., New Delhi (Agarwal and Sarbhoy 1979); *Ziziphus xylopyra* Jabalpur, Madhya Pradesh: (Sahni 1964); *Z. rotundifolia*, Majhgawan, UP (Sydow and Mitter 1933); *Z. oenoplia* and *Z. jujuba*, UP (Tandon 1935).

Remarks: This is a new record of the fungus in Maharashtra state.

Pirozynskiella solanina (Sacc. & P. Syd.) S. Hughes, *Mycologia* 99(4): 632 2007. Figure 62

=*Helminthosporium solaninum* Sacc. & P. Syd. [as 'Helmisporium'], in Saccardo

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Pleosporomycetidae, Pleosporales, Massarinaceae.

Specimen examined: On the leaves of *J. multiflorum* (Oleaceae), Kudal, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 20.01.2012, RD, 200080 BSI (WC).

Notes: *Pirozynskiella*, typified by *P. solaninum* comb. nov. (Sacc. & P. Syd.) S. Hughes has an obligate association with asterinaceous fungi. However, only two species of fungus have been reported worldwide. Remarks: This is the first record of the fungus from India.

Prillieuxina polyalthiae Hosag. & T.K. Abraham, *Indian Phytopath.* 51(4):391 1999. Figure 63

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Dothideomycetidae, Asterinales, Asterinaceae.

Specimen examined: On living leaves of *Desmodium* sp. (Leguminosae), Akeri, Sawantwadi, Sindhudurg Dist., Maharashtra, India, 20.01.2012, RD, BSI (WC) 200041.

Known distribution: On living leaves of *Polyalthia longifolia* (Sonn.) Thwaites (Annonaceae) from Kerala (Hosagoudar and Abraham 1998).

Remarks: This is a new record of fungus from Maharashtra's forest and a new record of *Desmodium* sp.

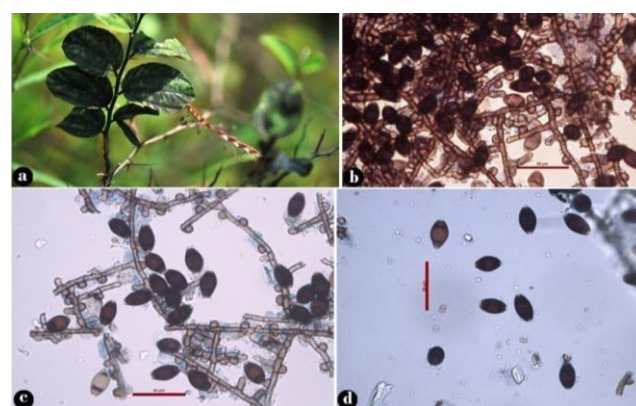


Figure 61. *Mitteriella ziziphina* (a) Black mildews of *Ziziphus jujuba* (b-c) Mycelia, appressoria, phialides and ascospores (d) ascospores. [Scale bar: b-d = 50 µm]



Figure 62. *Pirozynskiella solanina* (a) Infected leaves of *Jasminum multiflorum* (b) Conidiophores (c-d) Conidiophores and conidia. [Scale bar : b, d = 50 µm; c = 100 µm]

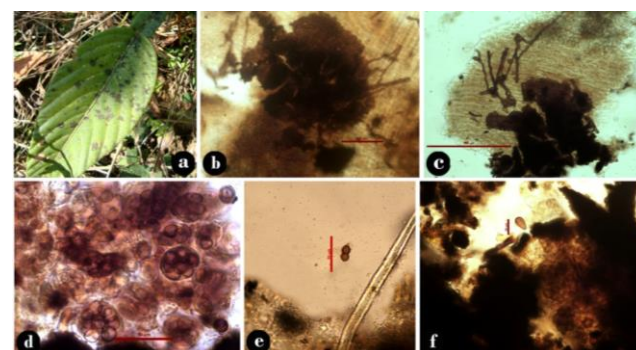


Figure 63. *Prillieuxina polyalthiae* (a) Black mildews of *Desmodium* sp. (b-c) Thyriothechia (d) Asci (e) Ascospores (f) Pycnothyriospore. [Scale bar : b, c = 100 µm; d, e = 50 µm; f = 20 µm]

Questieriella strychni Hosag., *J. Econ. Taxon. Bot.* 28(1): 196 2004. Figure 64

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Incertae sedis, Incertae sedis, Englerulaceae.

Specimen examined: On the leaves of *P. pinnata* (Leguminosae), Kesari, Sawantwadi Tal., Sindhudurg Dist., Maharashtra, India, 21.01.2012, RD, 200163 BSI (WC).

Known distribution: Kerala, Karnataka (Bilgrami et al. 1991; Maheshwari et al. 2012).

Notes: Worldwide, 19 species of *Questieriella* have been reported.

Remarks: This is the first record of the fungus from the forests of Maharashtra, India.

Sarcinella cassiae-fistulae Hosag. & Shajivaz in Hosagoudar, *Zoos' Print Journal* 17 (12): 947 2002. Figure 65

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Incertae sedis, Incertae sedis, Englerulaceae.

Specimen examined: On the leaves of *Cassia fistula* L. (Leguminosae), on the way to Dahanu, Thane Dist., Maharashtra, India, 17.10.2012, RD, 201065 BSI (WC).

Notes: *S. cassiae* Munjal and Kapoor (1963) is known as *Cassia tora* and *C. occidentalis* from Belgaum, Karnataka, and Bhimtal, Kumaon. However, *S. cassiae-fistulae* differs from it in having thin hypophyllous colonies, having only sarciniform and smaller conidia

Remarks: This is a new record of the species from Maharashtra.

Sarcinella cryptolepidae Pande, *M.V.M. Patrika* 13: 1, 1978. Figure 66

Specimen examined: On living leaves of *Cryptolepis buehneri* (Apocynaceae), East Melghat Tiger Reserve, Amravati Dist., Maharashtra, India, 16.01.2014, RD, 197086 BSI (WC).

Known distribution: India, Maharashtra, India, Poona, on leaves of *C. buehneri* (Periplocaceae) (Pande 1978).

Remarks: This is the second report of the occurrence of fungus from Maharashtra.

Sarcinella cryptostegiae (Singh, 1993). Figure 67

Specimen examined: On the leaves of a *Cryptostegia* sp. (Periplocaceae), Malshej Hills, Pune Dist., Maharashtra, India, 20.10.2012, RD, 201193 BSI (WC).

Remarks: This is a new record of the species from Maharashtra.

Sarcinella diospyri R.C. Rajak & Soni, *Indian J. Mycol. Plant Path.* 11 (1): 89 1981. Figure 68

Specimen examined: On living leaves of *Diospyros* sp. (Ebenaceae), Pench TR, (Part of Nagpur Dist.), Maharashtra, India, 13.01.2014, RD, 197021 BSI (WC).

Known distribution: Amarkantak, (MP); Gorakhpur (UP).

Remarks: This is a new record of the species from Maharashtra.



Figure 64. *Questieriella strychni* (a) Black midveins of *Pongamia pinnata* (b-c) Mycelia with appressoria (d-e) *Questieriella* type of conidia. [Scale bar : (b-e) = 50 µm]

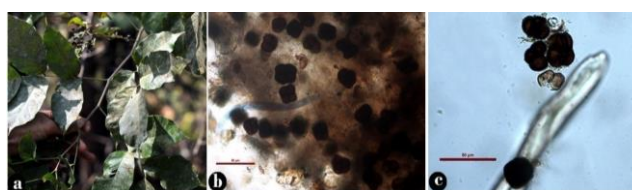


Figure 65. *Sarcinella cassiae-fistulae* (a) Black mildews of *Cassia fistula* (b-d) Hyphae, appressoria and conidia. [Scale bar : (b-d) = 50 µm]

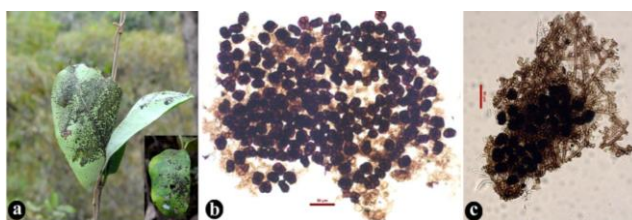


Figure 66. *Sarcinella cryptolepidae* (a) Black mildews of *Cryptolepis buehneri* (b-c) Hyphae, appressoria and sarciniform conidia. [Scale bar : b, c = 50 µm]



Figure 67. *Sarcinella cryptostegiae* (a) Black mildews of *Cryptostegia* sp. (b) Hyphae, appressoria, conidiophores, and conidia (c) Sarciniform conidia with colonies of *Schiffnerula* sp. [Scale bar: b, c = 50 µm]

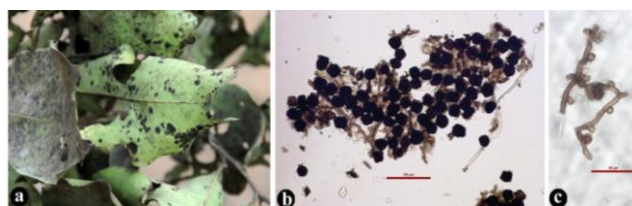


Figure 68. *Sarcinella diospyri* (a) Black mildews of *Diospyros* sp. (b) Hyphae, appressoria and sarciniform conidia (c) Appressoria [Scale bar: b = 100 µm; c = 50 µm]

Sarcinella gmelinae Hosag. Archana, Harish, Riju & D.K. Agarwal, *Indian Phytopath.* 61 (2): 247 2008. Figure 69

Specimen examined: On the leaves of *Tectona grandis* L.f. (Lamiaceae), Pulachiwadi, Thane Dist., Maharashtra, India, 18.10.2012, RD, 201119 BSI (WC).

Known distribution: on leaves of *Gmelina arborea* Roxb. ex Sm. from Kerala, India.

Remarks: This is a new record of the fungus from Maharashtra.

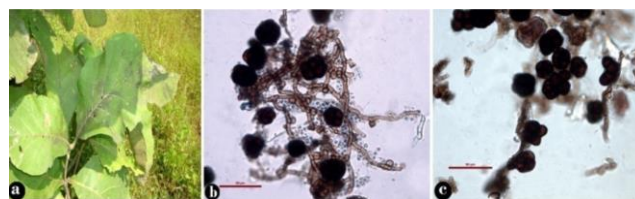


Figure 69. *Sarcinella gmelinae* (a) Black mildews of *Tectona grandis* (b-c) Hyphae, appressoria, conidiophores, and conidia. [Scale bar: b, c = 50 µm]

Sarcinella gymnosporiae Subhedar & Rao ex Hosag. in Hosagoudar, *Zoos' Print Journal* 17 (8): 837 2002. Figure 70

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Incertae sedis, Incertae sedis, Englerulaceae.

Specimen examined: On the leaves of unidentified plant sp.-10, on the way to Dahanu, Thane Dist., Maharashtra, India, 17.10.2012, RD, 201099 BSI (WC).

Known distribution: on leaves of *Gymnosporia rothiana* M.A. Lawson Maharashtra, Pune (Rao 1968).

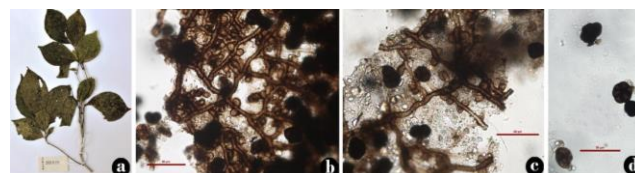


Figure 70. *Sarcinella gymnosporiae* (a) Black mildews of unidentified plant (b-c) Hyphae, appressoria, conidiophores, and conidia (d) Conidia. [Scale bar: (b-d) = 50 µm]

Sarcinella loranthacearum Hosag., Jac. Thomas & D.K. Agarwal *J. Yeast Fungal Res.* 2 (5): 85 2011. Figure 71

Specimen examined: On the leaves of *Firmiana colorata* (Roxb.) R.Br. (Malvaceae), Suryamal, Thane Dist., Maharashtra, India, 16.10.2012, RD, 201149 BSI (WC).

Remarks: No species of *Sarcinella* have been reported on *F. colorata*. Thus it is a new record of the association of *S. loranthacearum* with *F. colorata*.



Figure 71. *Sarcinella loranthacearum* (a) Black mildews of *Firmiana colorata* (b) Hyphae, appressoria, conidiophores, and conidia (c) Conidia. [Scale bar: b = 50 µm; c = 25 µm]

Sarcinella sp. Figure 72

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Incertae sedis, Incertae sedis, Englerulaceae.

Specimen examined: On living leaves of *Elaeagnus conferta* L. (Elaeagnaceae) Location 2, Chandoli National Park, Satara Dist., Maharashtra, India, 12.02.2015, RD, 201723 BSI (WC).

Remarks: No species of *Sarcinella* have been reported on *E. conferta*. Thus it is the first report of the occurrence of *Sarcinella* on *E. conferta*.

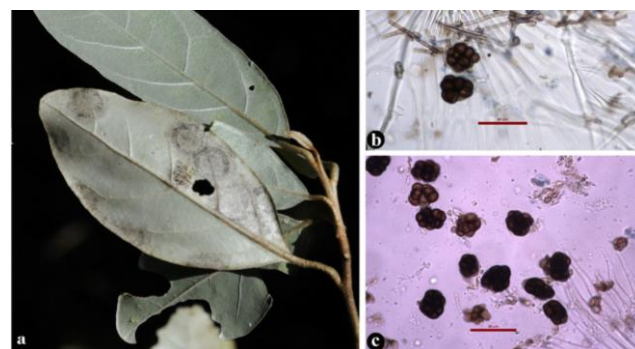


Figure 72. *Sarcinella* sp. (a) Sooty mold on *Elaeagnus conferta* (b) Hyphae, appressoria and conidia (c) Conidia. [Scale bar: b, c = 50 µm]

Schiffnerula celastris Hosag., Riju & Sabeena, in Hosagoudar, Riju & Sabeena, *Indian Journal of Science and Technology* 1(3): 1 2008. Figure 73

Fungi, Ascomycota, Pezizomycotina, Dothideomycetes, Incertae sedis, Incertae sedis, Englerulaceae.

Specimen examined: On the leaves of *Celastrus paniculatus* Willd. (Celastraceae), Toranmal WLS, Nandurbar Dist., Maharashtra, India, 21.09.2014, RD, 196648 BSI (WC).

Known distribution: Munnar, Wayanad, Padinjarethara (Kerala); Katarnia Ghat (Uttar Pradesh); Pateghar (Maharashtra); Kodagu (Karnataka) (Bigrani et al. 1991; Maheshwari et al. 2012).

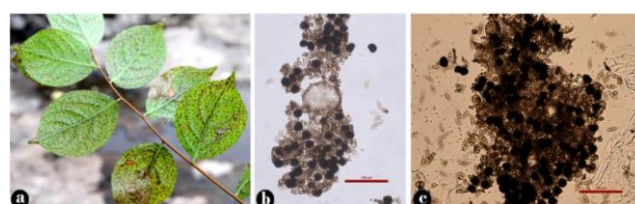


Figure 73. *Schiffnerula celastris* (a) Black mildews of *Celastrus paniculatus* (b) Colonies having appressoria, conidiophores, thyriothecia, and sarcinellate conidia (c) Questieriella conidia and sarcinellate conidia. [Scale bar: b, c = 100 µm]

Statistical results

As shown in Figure 2 (A), *Meliola* (Fam. Meliolaceae) was the dominant genus with 35 species, followed by *Asterina* (12) fam. Asterinaceae and *Sarcinella* (8) Fam. Englerulaceae. As Figure 74 A shows, *M. mollis* was the dominant taxon, identified from a maximum of 5 collections, 633 followed by *Sarcinella* sp. (4), *Meliola eugeniae-stocksii* (3), *Meliola ixorae* var. *macrospora* (3). Diversity measures (Table 2) were calculated by combining species richness with evenness (Table 2). Gini-Simpson's Index was 0.9818, and Shannon's Index was 4.1668. Pielou's evenness index was 0.9743, while true diversity, calculated as an effective number of species was 66, less than observed species richness (74).

Discussion

The present paper examines the diversity of Maharashtra's black mildews from taxonomic and ecological perspectives. Some areas of Maharashtra are well explored concerning documentation of black mildew fungi. E.g., Bhise et al. (2015) reported 46 new records for the state of Maharashtra from Mahabaleshwar alone. However, most of the work on black mildew is reported from the Western Ghats region of Kerala, Tamil Nadu, and Karnataka states (Bhise et al. 2015).

Therefore, there was a need to document the black mildew of Maharashtra. Consequently, greater emphasis was laid on extensive geographical coverage during the field surveys. All the major forest types within the state of Maharashtra were visited, with special emphasis on densely forested areas of Western Maharashtra (which included biodiversity hotspots of Western Ghats) and tiger reserves and protected areas of Northern Maharashtra. The present study is also unique in incorporating the ecological dimensions of black mildew. A total of 72 species under 14 genera were identified from 87 collections. The authors earlier published some fungi documented in Table 2. However, the focus and scope of those publications were entirely different, viz., on the percentage distribution of disease symptoms (Dubey and Pandey 2017) and enumeration and ecology of foliicolous fungal taxa (Dubey and Pandey 2019, 2022a, b).

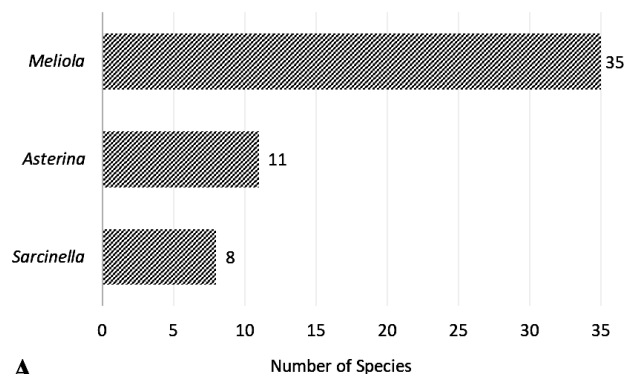
Further detailed studies on Maharashtra's black mildew fungi revealed some of these fungi as new records to India, new records to Maharashtra state, and new host records to

India, which is mainly highlighted in the present work. The present study on black mildew fungi of Maharashtra state of India resulted in three new records of fungi to India, 31 new host records to India, 40 new records of fungi to the Maharashtra state of India, and one var. nov. viz., *A. jasmini* Hansf. var. *koyani* var. nov., depicted by checklist and Figures. It was admitted that among the myriads of fungi, *Meliola* was the most dominating genus and was represented by 35 species, while *M. mollis* was the dominant taxon, identified from a maximum of five collections. More than 90% of black mildew species reported in the present work are collected from the Western Ghats districts of Maharashtra. Besides taxonomy, we also calculated diversity measures to shed light on the ecological aspects of the black mildew fungi. The study area is highly diverse, as evidenced by high values of Gini-Simpson's Index (= 0.9818) and Shannon's Index (= 4.1668). A high value of Pielou's evenness index ($J' = 0.9743$) shows high equitability in species distribution. Moreover, to correct observed species richness for observed evenness, a measure of an effective number of species was calculated from Shannon's Index on examination of true diversity. True diversity or an effective number of species for the study area (64) is less than species richness or observed number of species (72) due to the absence of a perfectly equitable distribution of species ($J' \neq 1$).

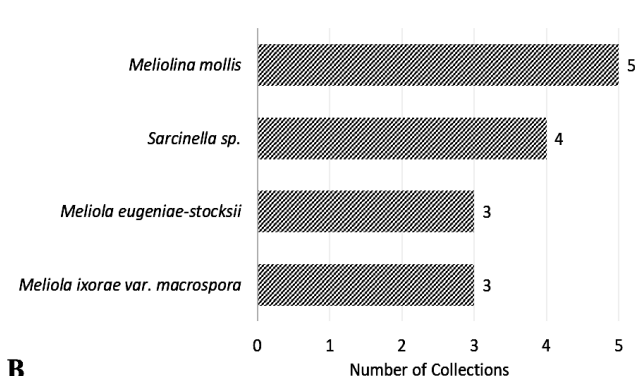
The present study thus provides important insights into the taxonomy, distribution, and ecology of black mildews of Maharashtra. However, the study also suggests the need for more intensive studies at a smaller geographical scale, such as a protected area or a district, as immense diversity is yet to be explored, which can not be captured in more geographically extensive studies.

Table 2. Diversity measures

Species Richness = Observed number of species	72
Simpson's Index (D)	0.0182
Gini Simpson's Index ($1-D$)	0.9818
Shannon's Index (H)	4.1668
Pielou's evenness index (J')	0.9743
True Diversity= Effective number of Species (ENS_H)= e^H	64



A



B

B

Figure 74. Dominant taxa. A. Fungal genera with the highest number of species. B Fungal taxa obtained from the highest number of collections

Table 1. Documentation of new records /new host records of black mildew fungi

Name of Fungi	Family	Host plant	Collection no.	Location in the state of Maharashtra, India	Date	New record for India	New record to Maharashtra State	New host record to India
<i>Amazonia elaeocarp</i>	Meliolaceae	<i>Leea indica</i>	200117	Kesari, Sindhudurg	21.01.2012		New record of fungus in Maharashtra	New Host record from India
<i>Amazonia syzygii</i>	Meliolaceae	<i>Syzygium cumini</i>	201751	Location 1, Metindoli, Koyna WLS, Satara Dist.	13.02.2015		New record of fungus in Maharashtra	
<i>Asteridiella depokensis</i>	Meliolaceae	<i>Vitex negundo</i>	200081	Kudal, Sawantwadi, Sindhudurg Dist.	21.01.2012		New record of fungus in Maharashtra	New Host record from India
<i>Asterina capparis</i>	Asterinaceae	<i>Capparis</i> sp.	200224	Amboli Ghat, Sindhudurg Dist.	22.01.2012		New record of fungus in Maharashtra	New Host record from India
<i>Asterina delicatula</i>	Asterinaceae	<i>Jasminum</i> sp.	200075	Sawantwadi, Sindhudurg	20.01.2012		New record of fungus in Maharashtra	New Host record from India
<i>Asterina henianii</i>	Asterinaceae	<i>Syzygium cumini</i>	201642	Location 1,Dajipur WLS, Kolhapur	09.02.2015		New record of fungus in Maharashtra	
<i>Asterina hydrocotyles</i>	Asterinaceae	<i>Lawsonia inermis</i>	196234	Junnar Forest, Pune Dist.	21.09.2013		New record of fungus in Maharashtra	New Host record from India
<i>Asterina jasmini</i> Hansf. var. <i>koyani</i> var.nov.	Asterinaceae	<i>Jasminum malabaricum</i>	201731	Chandoli NP, Sangli Dist.	12.02.2015	New variety		
<i>Asterina jasminicola</i>	Asterinaceae	<i>Jasminum multiflorum</i>	200080	Kudal, Sawantwadi, Sindhudurg Dist.	21.01.2012		New record of fungus in Maharashtra	
<i>Asterina wrightiae</i>	Asterinaceae	<i>Lagerstroemia</i> sp.	199560	Khandala, Pune Dist.	26.09.2011			New Host record from India
<i>Asterina wrightii</i>	Asterinaceae	<i>Paramignya monophylla</i>	194051	Forest Range, Dapoli, Ratnagiri	26.01.2013			New Host record from India
<i>Balladyna pavettae</i>	Balladynaceae	<i>Pavetta crassicaulis</i>	200326	Mahabaleshwar, Satara Dist.	24.01.2012	New record of the fungal species in India		New Host record from India
<i>Balladyna pavettae</i>	Balladynaceae	<i>Synedrella nodiflora</i>	200026	Akeri, Sawantwadi , Sindhudurg	20.01.2012			New Host record from India
<i>Balladyna ugandensis</i>	Parodiopsidaceae	<i>Pavetta</i> sp.	199628	Teragaon, Bhimashankar WLS, Pune Dist.	28.09.2011			New Host record from India
<i>Balladyna vanderystii</i>	Parodiopsidaceae	<i>Catunaregam spinosa</i>	200993	Kodawali, Bhimashankar WLS, Pune Dist.	29.09.2011		New record of fungus in Maharashtra	New Host record from India
<i>Balladyna velutina</i>	Parodiopsidaceae	<i>Pavetta indica</i>	196268	HarishchandragadWLS, Ahmednagar	21.09.2013	New record of the fungal species in India		
<i>Meliola agrostistachydis</i>	Meliolaceae	<i>Agrostistachys</i> sp.	201745	Location 1, Metindoli, Koyna WLS, Satara Dist.	13.02.2015		New record of fungus in Maharashtra	
<i>Meliola allophyli-serrulati</i>	Meliolaceae	<i>Allophylus</i> sp.	200143	Fanaswadi, Sawantwadi , Sindhudurg Dist.	21.01.2012		New record of fungus in Maharashtra	

<i>Meliola alstoniae</i>	Meliolaceae	Unidentified plant sp. 8	200157	Kesari, Sawantwadi Sindhudurg Dist.	21.01.2012	New record of fungus in Maharashtra	
<i>Meliola buteae</i>	Meliolaceae	<i>Butea monosperma</i>	196384	Sanjay gandhi NP, Mumbai	25.09.2013	New record of fungus in Maharashtra	
<i>Meliola carissae</i>	Meliolaceae	<i>Carissa spinarum</i>	201027	On the way to Jhap, Thane Dist.	16.10.2012	New record of fungus in Maharashtra	
<i>Meliola desmodii- triquetri</i>	Meliolaceae	<i>Desmodium triflorum</i>	200010	Akeri, Sawantwadi (Sindhudurg)	20.01.2012	New record of fungus in Maharashtra	
<i>Meliola diospyri</i>	Meliolaceae	<i>Diospyros</i> sp.	201629	Location 1, Dajipur WLS, Kolhapur Dist.	09.02.2015	New record of fungus in Maharashtra	
<i>Meliola eugeniae- jamboloidis</i>	Meliolaceae	<i>Carissa spinarum</i>	200084	Kudal, Sawantwadi Sindhudurg Dist.	21.01.2012	New record of fungus in Maharashtra	
<i>Meliola eugeniae-stocksii</i>	Meliolaceae	<i>Ficus</i> sp.	201782	Radhanagari WLS	10.02.2015		New Host record from India
<i>Meliola eugeniae-stocksii</i>	Meliolaceae	<i>Ixora brachiata</i>	200178	Amboli Ghat, Sindhudurg Dist.	22.01.2012	New record of fungus in Maharashtra	New Host record from India
<i>Meliola eugeniae-stocksii</i>	Meliolaceae	<i>Ixora brachiata</i>	200130	Fanaswadi, Sawantwadi	21.01.2012		New Host record from India
<i>Meliola flemingiicola</i>	Meliolaceae	<i>Lagerstroemia</i> sp.	200371	Pasarni Ghat, Satara Dist.	25.01.2012	New record of fungus in Maharashtra	New Host record from India
<i>Meliola garhwalensis</i>	Meliolaceae	<i>Jasminum malabaricum</i>	200335	Old Mahabaleshwar	24.01.2012	New record of fungus in Maharashtra	New Host record from India
<i>Meliola holarrhenae</i>	Meliolaceae	<i>Holarrhena pubescens</i>	196402	Sanjay Gandhi NP	25.09.2013	New record of fungus in Maharashtra	
<i>Meliola holigarnae</i>	Meliolaceae	<i>Holigarna</i> sp.	201754	Location 1, Metindoli, Koyna WLS, Satara Dist., Maharashtra	13.02.2015	New record of fungus in Maharashtra	
<i>Meliola hyptidis</i>	Meliolaceae	<i>Plectranthus</i> sp.	196393	Sanjay Gandhi NP, Mumbai	25.09.2013		New Host record from India
<i>Meliola hyptidis</i>	Meliolaceae	<i>Volkameria inermis</i> syn. <i>Clerodendrum inerme</i>	200085	Kudal, Sawantwadi, Sindhudurg Dist.	21.01.2012		New Host record from India
<i>Meliola ixorae</i> Yates var. <i>macrospora</i>	Meliolaceae	<i>Ixora brachiata</i>	200215	Location 1, Amboli Ghat, Sindhudurg Dist.	22.01.2012		New Host record from India
<i>Meliola ixorae</i> Yates var. <i>macrospora</i>	Meliolaceae	<i>Ixora brachiata</i>	200180	Location 2, Amboli Ghat, Sindhudurg Dist.	22.01.2012		New Host record from India
<i>Meliola ixorae-coccineae</i>	Meliolaceae	<i>Ixora brachiata</i>	200180	Amboli Ghat	22.01.2012		New Host record from India
<i>Meliola jasminicola</i>	Meliolaceae	<i>Jasminum multiflorum</i>	200080	Kudal, Sawantwadi, ,Sindhudurg Dist.	21.01.2012	New record of fungus in Maharashtra	New Host record from India
<i>Meliola jasminicola</i>	Meliolaceae	<i>Strychnos nux-vomica</i>	200083	Chillara, Sawantwadi , Sindhudurg	21.01.2012		New Host record from India
<i>Meliola mangiferae</i>	Meliolaceae	<i>Mangifera indica</i>	200219	On the way to Vengrula, Amboli Ghat	22.01.2012	New record of fungus in Maharashtra	
<i>Meliola melanoxylonis</i>	Meliolaceae	<i>Carissa spinarum</i>	200935	Kirbet, Ratnagiri	23.01.2013		New Host record from India

<i>Meliola mitragynae</i>	Meliolaceae	<i>Mitragyna parvifolia</i>	196410	Sanjay Gandhi NP, Mumbai	25.09.2013		New record of fungus in Maharashtra	
<i>Meliola nothopegiae</i>	Meliolaceae	<i>Nothopegia</i> sp.	201606	Location 1, Dajipur WLS, Kolhapur District,	09.02.2015		New record of fungus in Maharashtra	
<i>Meliola pandanacearum</i>	Meliolaceae	<i>Pandanus tectorius</i>	200140	Fanaswadi, Sawantwadi (Sindhudurg)	21.01.2012		New record of fungus in Maharashtra	
<i>Meliola pongamiae</i>	Meliolaceae	<i>Pongamia pinnata</i>	200163	Kesari, Sawantwadi, Sindhudurg	21.01.2012		New record of fungus in Maharashtra	
<i>Meliola semecarpi-anacardii</i>	Meliolaceae	<i>Semecarpus anacardium</i>	200158	Kesari, Sawantwadi, Sindhudurg	21.01.2012		New record of fungus in Maharashtra	
<i>Meliola tylophorae</i>	Meliolaceae	<i>Tylophora</i> sp.	200038	Akeri, Sawantwadi , Sindhudurg	20.01.2012		New record of fungus in Maharashtra	
<i>Meliola tylophorae-indicae</i>	Meliolaceae	<i>Tylophora indica</i>	200150	Kesari, Sawantwadi, Sindhudurg	21.01.2012		New record of fungus in Maharashtra	
<i>Meliola unoncola</i>	Meliolaceae	<i>Diospyros</i> sp.	196477	Phansad WLS Raigad Dist.	28.09.2013		New record of fungus in Maharashtra	New Host record from India
<i>Meliolina mollis</i>	Meliolaceae	<i>Leea indica</i>	200117	Kesari, Sawantwadi (Sindhudurg)	21.01.2012			New Host record from India
<i>Meliolina mollis</i>	Meliolaceae	<i>Memecylon umbellatum</i>	200289	PWD Rest House, Mahabaleshwar	24.01.2012			New Host record from India
<i>Meliolina mollis</i>	Meliolaceae	<i>Persicaria auriculata</i>	200314	Old Mahabaleshwar	24.01.2012			New Host record from India
<i>Mitteriella ziziphina</i>	Englerulaceae	<i>Ziziphus jujuba</i>	201036	Shikur, Thane Dist.	16.10.2012		New record of fungus in Maharashtra	
<i>Pirozynskiella solanina</i>	Massarinaceae	<i>Jasminum multiflorum</i>	200080	Kudal, Sawantwadi, Sindhudurg Dist.	21.1.2012	New record of the fungal species in India		
<i>Prillieuxina polyalthiae</i>	Asterinaceae	<i>Desmodium</i> sp.	200041	Akeri, Sawantwadi, Sindhudurg Dist.	20.1.2012		New record of fungus in Maharashtra	New Host record from India
<i>Questieriella strychni</i>	Englerulaceae	<i>Pongamia pinnata</i>	200163	Kesari, Sawantwadi Sindhudurg Dist	21.01.2012		New record of fungus in Maharashtra	
<i>Sarcinella cassiae-fistulae</i>	Englerulaceae	<i>Cassia fistula</i>	201065	On the way to Dahanu, Dahanu, Thane Dist.	17.10.2012		New record of fungus in Maharashtra	
<i>Sarcinella cryptostegiae</i>	Englerulaceae	<i>Cryptostegia</i> sp.	201193	Malshej Hills, Pune	20.10.2012		New record of fungus in Maharashtra	
<i>Sarcinella diospyri</i>	Englerulaceae	<i>Diospyros</i> sp.	197021	Pench TR, Nagpur	13.01.2014		New record of fungus in Maharashtra	
<i>Sarcinella gmelinae</i>	Englerulaceae	<i>Tectona grandis</i>	201119	Pulachiwadi, Thane Dist.	18.10.2012		New record of fungus in Maharashtra	
<i>Sarcinella lorantheae</i>	Englerulaceae	<i>Firmiana colorata</i>	201149	Suryamal, Thane Dist.	16.10.2012			New Host record from India
<i>Sarcinella</i> sp.	Englerulaceae	<i>Elaeagnus conferta</i>	201723	Location 2, Chandoli NP, Satara Dist.	12.02.2015			New Host record from India
<i>Schiffnerula celastri</i>	Englerulaceae	<i>Celastrus paniculatus</i>	196648	Nandurbar	21.09.2014		New record of fungus in Maharashtra	

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