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MACROFUNGI ASSOCIATED WITH RELICT ENDEMIC *LIQUIDAMBAR ORIENTALIS* MILL.

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Abstract

Liquidambar orientalis Mill. is one of the most important relict-endemic species and native to south-west part of Turkey. This fungi are parasitic and saprophytic for *L. orientalis*. Parasitic and saprophytic fungi which are harmful for *L. orientalis* forest were listed. Two of them; *Mollisia cinerea* (Batsch) P. Karst and *Crepidotus applanatus* (Pers.) P. Kumm., are new records for Turkish mycota. They were illustrated and described.

Introduction

Liquidambar orientalis is known as oriental sweetgum and it is one of the most important relict-endemic taxon of Turkey. The flat deep hydromorphic soils rich in surface waters during summer months are the most productive sites for the dense stands of *L. orientalis*. It grows in the wetlands and native to southwest part of Turkey. Today the forests of this species show a very restricted distribution such as; Antalya (Kaş, Kalkan, Serik), Aydın (Çine), Burdur (Bucak), Denizli (Acıpayam), Isparta (Sütçüler), Muğla (Dalaman, Datça, Fethiye, Köyceğiz, Marmaris, Milas, Ula, Yatağan,) and İçel (Silifke, Göksu) Provinces and not naturally Island of Rhodes in Greece and Cyprus (Hill 1952, Pamukçuoğlu 1964, Meikle 1977, Tyler *et al*. 1981, Davis 1982). It lives 100 - 300 m height in coastline and 850 - 900 m height in upcountry (Öztürk *et al*. 2008). Because of wetland and humidity habitat *L. orientalis* forests host lots of macro- and microfungal species.

L. orientalis has a high economic value due to storax of it. Many components of storax were characterized, but the major ones were terpinen-4-ol, α-terpinol, sabinene and γ-terpinene (Sağdıç *et al.* 2005). It is used as a medicine and cosmetic since ancient times. Nowadays it is used for phytotherapic purposes in the west Anatolia. The storax produced by injuring tree and has good antiseptic properties. Also it is used as a parasiticide and for the treatment of some skin diseases in Turkish folk medicine. (Hafızoğlu 1982, Baytop 1984, Duru *et al*. 2002, Özturk *et al*. 2004, Kim *et al*. 2008, Lee *et al.* 2009). So its storax is valuable and many villagers damage trees for earn money.

Basic reasons involved in the decrease of the genetic pool of *L. orientalis* are deliberate wounding, continuous extraction of balsam for industrial evaluation, habitat destruction, followed by a change of the land use and urban development pressures (Öztürk *et al*. 2008). Although continuing studies such as; cultivation seedlings from seed, protection etc., they are decreasing day by day. There is an urgent need for its *in situ* conservation.

Liqidambar orientalis forests are very suitable habitats for growth of fungi, because these forests are humid and wet land almost throughout the year. Also macro and micro parasitic and saprophytic fungi which live on rotten woods of tree and its fruits are another danger for *L. orientalis* forests. All these fungi are damaging woods and fruits of the tree.

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The aim of this study was to determine macrofungi which were associated with *L. orientalis* forests and to contribute to macrofungal diversity of Turkey with new macrofungal records.

Materials and Methods

The specimens were collected from six localities of *Liquidambar orientalis* forests within Muğla Province as listed in Table 1, between 2010 and 2013 years. The field studies were conducted in autumn and spring. In field studies morphological and ecological characteristics of the macrofungi were recorded and photographed. After field studies, specimens were taken to the laboratory for further studies. Spores and ultrastructural constructions were photographed. Specimens were identified with the help of Marchand (1971-1986), Watling (1982), Moser (1983), Breitenbach and Kränzlin (1984-2000), Cappelli (1984), Pacioni (1985), Watling and Gregory (1987, 1989), Ellis and Ellis (1990), Knudsen and Vesterholt (2008). The new records for Turkey were checked with the relevant literature: (Doğan *et al*. 2005, Solak *et al*. 2007, Kaya *et al*. 2012, Sesli and Denchev 2013, Akata *et al*. 2013, Solak *et al*. 2014, Akata and Doğan 2015, Güngör *et al*. 2015, Solak *et al.* 2015).

Table 1. Macrofungi collection localities.

No.	Localities	Coordinates	Altitudes (m)
1	Ula, Kızılyaka village	N 37°00'33" E 28°27'32"	97 - 102
2	Marmaris, Çetibeli village	N 36°58'07" E 28°17'04"	29 - 35
3	Marmaris-Datça way, Değirmenyanı place	N 36°50'08" E 28°08'44"	16 - 25
4	Köyceğiz, Toparlar village	N 36°59'31" E 28°38'49"	10 - 15
5	Fethiye, Yanıklar place	N 36°41'26" E 29°03'45"	7 - 16
6	Fethiye, Günlüklü 1 bay	N 36°43'04" E 29°01'24"	0 - 2

Results and Discussion

In this study 40 taxa belonging to 25 families were identified. These taxa are presented with their localities, habitats, collection dates, and accession numbers. Nomenclature is given according to Index Fungorum (Kirk 2011). Two of them; *Mollisia cinerea* and *Crepidotus applanatus* are new records for Turkish mycota as current checklists (Solak *et al*. 2007, 2015, Sesli and Denchev 2013).

Ascomycota Caval.-Sm.
Dermateaceae Fr.

1. *Mollisia cinerea* (Batsch) P. Karst

Fruit body sessile, 1 - 5 mm, nearly globose to cup-shaped, then expanded, undulating, hymenium grey to yellowish gray, underside grayish to brown, margins distinctly white especially in mature fruiting bodies, at the base with anchor type hyphae (Fig. 1a). Spores 7.0 - 7.8 × 1.8 - 2.2 µm cylindrical to clavate, slightly curved, hyaline, smooth, generally with oil drops (Fig. 1b). Asci 50 - 55 × 5.0 - 5.5 µm with amyloid pore (Fig. 1c). Paraphyses cylindrical, straight (Fig. 1d).

Ecology: Growing gregariously crowded on rottening wood of deciduous trees.

Specimen examined: Saprophytic on *L. orientalis*, locality 6, 28.04.2011, H 110.

Hemiphacidiaceae Korf

2. *Chlorencoelia versiformis* (Pers.) J.R. Dixon
   Saprophytic on twigs of *L. orientalis*, locality 4, 28.04.2011, H 74.

Pezizaceae Dumort.

3. *Peziza micropus* Pers.
   Saprophytic on *L. orientalis,* locality 6, 28.04.2011, H 97.
4. *Peziza depressa* Pers.
   In *L. orientalis* forest on soil, locality 4, 28.04.2011, H 78.

Pyronemataceae Corda

5. *Scutellinia umbrorum* (Fr.) Lambotte
   Saprophytic on twigs of *L. orientalis*, locality 4, 19.02.2011, H 72.

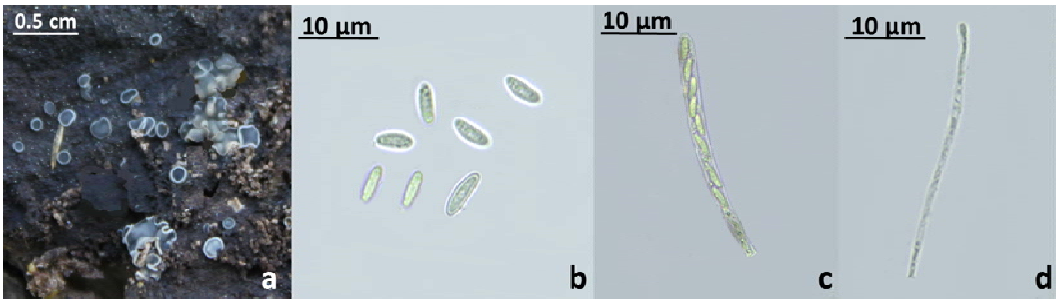

Fig. 1. *Mollisia cinerea*. a. Fruit bodies, b. Ascospores, c. Ascus and d. Paraphyses.

Xylariaceae Tul. & C. Tul.

6. *Daldinia concentrica* (Bolton) Ces. & De Not.
   Saprophytic on *L. orientalis*, locality 5, 19.02.2011, H 28.
7. *Xylaria longipes* Nitschke
   Saprophytic on *L. orientalis,* locality 2, 05.03.2011, H 36.

Basidiomycota R.T. Moore

Auriculariaceae Fr.

8. *Auricularia auricula-judae* (Bull.) Quél
   Parasitic- saprophytic on *L. orientalis*, locality 5, 19.02.2011, H 23.
9. *Auricularia mesenterica* (Dicks.) Pers
   Parasitic- saprophytic on *L. orientalis*, locality 5, 19.02.2011, H 24.

Bolbitiaceae Singer

10. *Panaeolus papilionaceus* (Bull.) Quél.
    In *L. orientalis* forest, on manure, locality 3, 05.03.2011, H 40.

Ceratobasidiaceae G.W. Martin

11. *Scotomyces subviolaceus* (Peck) Jülich
    Saprophytic on *L. orientalis*, locality, 19.02.2011, H 22. Saprophytic on *L. orientalis*, Locality 2, 05.03.2011, H 38.

Coniophoraceae Ulbr.

12. *Coniophora puteana* (Schumach.) P. Karst.
    Saprophytic on *L. orientalis*, locality 2, 05.03.2011, H 35.

Dacrymycetaceae J. Schröt.

13. *Calocera cornea* (Batsch) Fr.
    Saprophytic on *L. orientalis,* locality 6, 28.04.2011, H 97.
14. *Dacrymyces minor* Peck
    Saprophytic on twigs of *L. orientalis*, locality 4, 28.04.2011, H 75.

Ganodermataceae Donk

15. *Ganoderma applanatum* (Pers.) Pat.
    Parasitic-saprophytic on *L. orientalis*, locality 2, 05.03.2011, H 27.
16. *Ganoderma lucidum* (Curtis) P. Karst.
    Parasitic-saprophytic on *L. orientalis*, locality 1, 13.02.2011, H 12.
17. *Ganoderma resinaceum* Boud.
    Parasitic-saprophytic on *L. orientalis*, locality 4, 13.11.2013, H 675.

Hygrophoraceae Lotsy

18. *Hygrocybe nigrescens* (Quél.) Kühner
    In *L. orientalis* forest on soil, locality 4, 28.04.2011, H 76.

Hymenochaetaceae Donk

19. *Fuscoporia ferruginosa* (Schrad.) Murrill
    Parasitic-saprophytic on *L. orientalis*, locality 1, 13.02.2011, H 8.
20. *Fuscoporia torulosa* (Pers.) T. Wagner & M. Fisch.
    Parasitic-saprophytic on *L. orientalis*, locality 3, 05.03.2011, H 41.

I**nocybaceae** Jülich

21. *Crepidotus applanatus* (Pers.) P. Kumm.

Pileus 10 - 25 mm extent, sessile, spathulate, reniform to semi-orbicular, with maturing more or less pubescent, usually white fibrillose at the base, white to brownish or buff to cinnamon, hygrophanous, punctate, margin faintly striate when old or moist, incurved for a long time. Flesh whitish, odor faintly rubbery, taste mild. Lamellae narrowly adnate to decurrent, crowded, firstly white then light brownish, edges fimbriate to even (Fig. 2a). Spores 4.0 - 6.5 (5.5) µm, spherical to subglobose, light gray-yellow, weakly verrucose (Fig. 2b). Basidia 20 - 25 × 8 - 9 µm, clavate, 4 spored. Cheilocystidia 25 - 35 × 5 - 10 µm, clavate to ventricose. Clamp connection present.

Ecology: Solitary to greyarious on dead hardwood.

Specimen examined: Saprophytic on *L. orientalis*, locality 5, 28.04.2011, H 77.

22. *Crepidotus mollis* (Schaeff.) Staude
    Saprophytic on *L. orientalis*, locality 4, 19.02.2011, H 18.
23. *Crepidotus variabilis* (Pers.) P. Kumm.
    Saprophytic on *L. orientalis*, locality 1, 13.02.2011, H 18a.

Phanerochaetaceae Jülich

24. *Phanerochaete sordida* (P. Karst.) J. Erikss. & Ryvarden
    Saprophytic on *L. orientalis*, locality 1, 26.03.2011, H 54.

Pleurotaceae Kühner

25. *Pleurotus ostreatus* (Jacq.) P.Kumm.
    Saprophytic on *L. orientalis*, locality 5, 19.02.2011, H 27.

Pluteaceae Kotl. & Pouzar

26. *Pluteus insidiosus* Vellinga & Schreurs
    Saprophytic on *L. orientalis*, locality 1, 26.03.2011, H 55.

Polyporaceae Fr. ex Corda

27. *Fomes fomentarius* (L.) Fr.
    Parasitic-saprophytic on *L. orientalis*, locality 5, 19.02.2011, H 31.
28. *Lentinus tigrinus* (Bull.) Fr.
    Saprophytic on *L. orientalis*, locality 5, 19.02.2011, H 26; locality 1, 26.03.2011, H 60.
29. *Lenzites betulina* (L.) Fr.
    Saprophytic on *L. orientalis*, locality 1, 13.02.2011, H 12.
30. *Trametes versicolor* (L.) Lloyd
    Saprophytic on twigs of *L. orientalis*, locality 4, 19.02.2011, H 17. locality 5, 19.02.2011, H
30. Locality 1, 13.02.2011, H 14.
31. *Trichaptum biforme* (Fr.) Ryvarden
    Saprophytic on *L. orientalis*, locality 5, 19.02.2011, H 29.

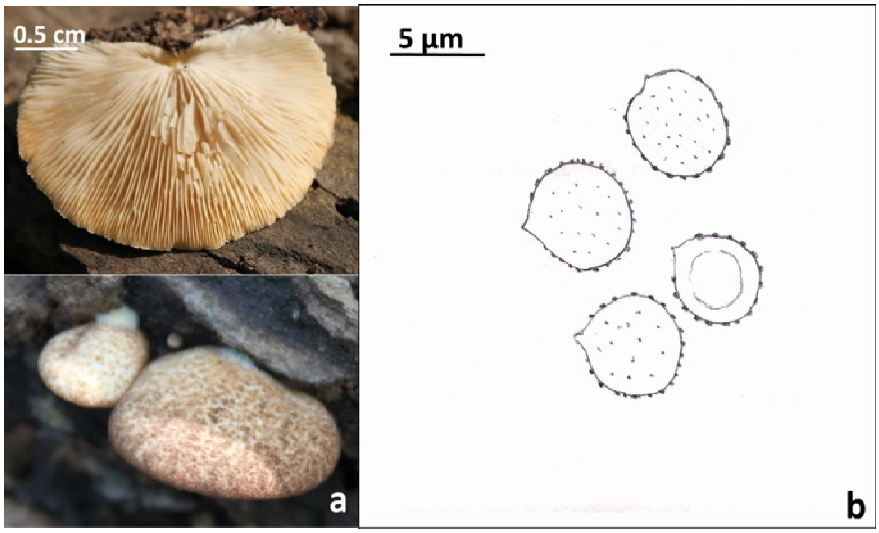

Fig. 2. *Crepidotus applanatus*. a. Fruit body and b. Basidiospores.

Psathyrellaceae Vilgalys, Moncalvo & Redhead

32. *Coprinellus disseminatus*
    In *L. orientalis* forest saprophytic on soil, locality 5, 19.02.2011, H 19; Locality 1, 26.03.2011, H 70.
33. *Coprinellus micaceus* (Bull.) Vilgalys, Hopple & Jacq. Johnson
    Saprophytic on soil, locality 3, 05.03.2011, H 39.

Schizophyllaceae Quél.

34. *Schizophyllum commune* Fr.
    Saprophytic on *L. orientalis*, locality 5, 19.02.2011, H 25.

Stereaceae Pilát

35. *Stereum hirsutum* (Willd.) Pers.
    Saprophytic on twigs of *L. orientalis*, locality 4, 19.02.2011, H 21. locality 1, 26.03.2011, H 74.

Strophariaceae Singer & A.H. Sm.

36. *Agrocybe cylindracea* (DC.) Maire
    Saprophytic on *L. orientalis*, locality 3, 05.03.2011, H 43.

37. *Agrocybe praecox* (Pers.) Fayod
    Saprophytic on soil in *L. orientalis* forest, locality 2, 05.03.2011, H 34.

Tremellaceae Fr.

38. *Tremella mesenterica* Retz.
    Saprophytic on twigs of *L. orientalis*, locality 4, 19.02.2011, H 15.

Tricholomataceae R. Heim

39. *Resupinatus trichotis* (Pers.) Singer
    Saprophytic on *L. orientalis*, locality 5, 28.04.2011, H 105.

Tubariaceae Vizzini

40. *Tubaria conspersa* (Pers.) Fayod
    Saprophytic on fruits of *L. orientalis*, locality 2, 05.03.2011, H 33.

Fourty taxa belonging to 25 families and 2 division were identified. Seven taxa belong to Ascomycota and 33 to Basidiomycota. Most of them are saprophytic on fruits, branches and stumps of *L. orientalis*. Six of them are parasitic which cause serious damage to trees. Another contribution of this study is the addition of *Crepidotus applanatus* and *Mollisia cinerea* at the species level.

Crepidotus applanatus is very similar with other *Crepidotus* (Fr.) Staude species macroscopically. But *C. applanatus* is easily distinguished from other *Crepidotus* species with their globose to subglobose and weakly verrucose spores and also differently shaped cheilocystidia.

Mollisia cinerea is very similar with *Tapesia fusca* (Pers.) Fuckel, *Mollisia melaleuca* (Fr.) Sacc. and *Mollisia ligni* (Desm.) P. Karst. But *T. fusca* differs from *M. cinerea* with their fruit bodies which develop on a feltwork of hyphae. *Mollisia melaleuca* and *M. ligni* also distinguished with their color.

It is important to develop conservation strategies for endemic species. Conservation strategies can be developed unless determines harmful organisms which cause damage to endemic species. With this study we listed macrofungi associated with *L. orientalis.*

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