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Myxomycetes of Mustafa Kemal University campus and environs (Turkey)

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Received: 22.03.2011 ● Accepted: 05.06.2012

Abstract: In this taxonomic study, myxomycetes of Tayfur Sökmen Campus (Hatay) were collected during 2010-2011. As a result of field and laboratory studies we reported 44 species of protosteliomycetes and myxomycetes. Three of these species (Didierma deplanatum Fr., Didymium megalosporum Berk & M.A.Curtis, and Lamproderma atrosporum Meyl.) are recorded for the first time from Turkey. Lamproderma atrosporum was treated with the moist chamber cultures method in the laboratory but Didymium megalosporum and Didierma deplanatum were determined naturally. The distribution, habitat, and collection numbers of the identified species are given.

Key words: Hatay, fungal diversity, new records, myxomycetes, Turkey

Introduction

Myxomycetes (acellular, non-cellular, plasmodial, or true slime moulds) are characterised by an amorphous, multinucleate, protoplasmic mass called the plasmodium as well as fruiting bodies (1-200 mm) with internally borne spores (5-20 µm). They have been known for more than 350 years based on Pankow’s figure and description of Lycogala epidendrum (L.) Fr. (Martin & Alexopoulos, 1969).

Myxomycetes have been classified in the kingdom Plantae (class Myxomycota) and the kingdom Animalia (class Mycetozoa). Because myxomycetes are typically found in the same habitats as fungi, they were treated as taxa within the kingdom Fungi (class Myxomycetes). Unlike fungi, myxomycetes do not excrete extracellular, digestive enzymes, and the role of myxomycetes in the environment is not as decomposers or pathogens (Keller & Braun, 1999). Bauldauf and Doolittle (1997) conducted a phylogenetic analysis of highly conserved, elongation factor 1-alpha (EF-1α) gene sequences and showed that myxomycetes are not fungi. Physiology, morphology, life history, and genetic analysis support the classification of myxomycetes in the kingdom Protoctista along with other eukaryotic microorganisms (Everhart & Keller, 2008).

Myxomycetes are common and relatively cosmopolitan in their distribution. They have been widely studied in worldwide, but those from Turkey are still poorly known. The number of known myxomycetes species in the world is about 1000 (Lado, 2001). The myxomycetes flora of Turkey has not been fully explored. The first extensive studies in Turkey were carried out by Finnish scientists (Härkönen & Uotila, 1983; Härkönen, 1987; Härkönen & Ukkola, 2000). In recent years some macrofungi and myxomycetes have been added to
the Turkish myxobiota by some researchers (Baba et al., 2008; Doğan & Karadelev, 2009; Alkan et al., 2010; Doğan et al., 2011; Demirel & Kaşık, 2012). So far, 226 species of myxomycetes have been reported from Turkey (Kaşık, 2010). While much research has been done on myxomycetes, the Turkish mycoflora are still incomplete and there have been no previous studies in Hatay. Now 3 taxa have been added to the Turkish myxomycetes flora as new records: *Diderma deplanatum* Fr., *Didymium megalosporum* Berk. & M.A.Curtis, and *Lamproderma atrosporum* Meyl.

**Description of the research area**

The myxomycete specimens in the current study were collected in and around the Tayfur Sökmen Campus of Mustafa Kemal University during 2010 and 2011. The campus is located outside the city of Hatay, in Alahan village district (Figure 1).

The area is situated in the Mediterranean phyto-geographical region and square C6 according to Davis’s grid system (Davis, 1965-1985). The research area is surrounded to the north by the Amanos Mountains and Alahan village, to the south by Amik plain, to the west by Dikmece village, and to the east by the town of Serinyol. The altitude of the land is 100 m in the region of the highway and the village of Alahan is 350 m a.s.l.

The study area is naturally covered with *Pinus brutia* Ten., scrub vegetation, and furigana formation. In this type of vegetation the woody species *Arbutus andrachne* L., *Quercus coccifera* L., and *Phillyrea latifolia* L. are found; also, in these regions *Olea europaea* L. is grown as a culture plant.

According to meteorological data from the directorate of Hatay, the highest average monthly temperature is in August (27.6 °C), while the lowest...
average monthly temperature is in December (7.7 °C). The average monthly maximum rainfall of Antakya is in December (192.4 mm), while the lowest average monthly rainfall is in August (3.5 mm) (MGM, 2007).

**Materials and methods**

The specimens on natural substrata, bark and debris, the bark of living trees, as well as on decaying bark, wood, leaves, and litter were collected. Natural mature fructifications were gently and directly collected from the substratum and placed in cardboard herbarium boxes. In addition, the fructifications of myxomycetes were as obtained from the moist chamber culture in the laboratory. The cultures were moistened with distilled water. The moist chambers were examined every day under a dissecting microscope. When developing myxomycetes were found, the moist chamber was allowed to dry slowly and the myxomycetes were then dried for 1 week. The same chambers were then rewetted for another 4-week period and examined as before (Martin et al., 1983; Stephenson & Stempen, 2000).

Microscopic and macroscopic features of the samples were determined in the laboratory. The morphological characters examined included fruiting bodies’ shape, size and colour, spore size and ornamentation, capillitium colour and branching, lime crystal size and morphology, and stalk colour and proportion. In addition, some photographs from characteristic qualitative objects were taken. All data were evaluated comparatively for taxonomical aims.

The myxomycete specimens were identified with the aid of Martin and Alexopoulos (1969), Neubert et al. (1993, 1995, 2000), and Sesli and Denchev (2008). The samples were prepared as fungarium material and stored in the laboratory of Department of Biology, Faculty of Science and Arts, Mustafa Kemal University in Hatay, and in the author’s personal collection.

**Results**

Forty-four species belonging to 11 families of myxomycetes from both the field and moist chamber culture were identified.
Liceaceae

7. *Licea biforis* Morgan
   Above Alahan village in coniferous woods, 36°19'55"N, 36°11'05"E, 350 m, 06.11.2010, Baba 26.

8. *Licea castanea* G.Lister
   Above Alahan village in coniferous woods, 36°19'55"N, 36°11'05"E, 350 m, 06.11.2010, Baba 30.

9. *Licea kleistobolus* G.W.Martin
   Above Alahan village in coniferous woods, 36°19'55"N, 36°11'05"E, 350 m, 06.11.2010, Baba 26.

10. *Licea minima* Fr.
    Above Alahan village in coniferous woods, 36°19'55"N, 36°11'05"E, 350 m, 06.11.2010, Baba 9, 48.

    Across from the Faculty of Medicine on debris of *Pinus* sp., 36°20'08"N, 36°11'54"E, 113 m, 16.01.2011, Baba 2.

    Anayazi village on debris, 36°19'00"N, 36°11'30"E, 130 m, 24.11.2010, Baba 11.

Reticulariaceae

    Züülufühan Cemetery on debris of wood, 36°19'00"N, 36°11'30"E, 130 m, 23.12.2010, Baba 10.

Physarales

Didymiaceae

    Syn.: *Leocarpus deplanatus* (Fr.) Fr.; *Chondrioderma deplanatum* (Fr.) Rostaf.; *Chondrioderma niveum* var. *deplanatum* (Fr.) Lister; *Diderma niveum* var. *deplanatum* (Fr.) G.Lister; *Diderma niveum* var. *deplanatum* (Fr.) Meyl.; *Diderma deplanatum* f. *pulverulentum* Meslin.

Sporocarps or curved or ring-shaped plasmodiocytes scattered or in small groups, pulvinate, sessile, 1-1.5 mm diam. white or pale cream-colored or lilaceous. Peridium double, the outer layer smooth, crustose, brittle, thick, the inner layer membranous, iridescent, deep orange below; columella either lacking or represented by a broad convex or thickened orange-brown base; capillitium consisting of dark purple, simple or sparsely branched threads, often bearing spiny or nodular enlargements; plasmodium white; spores rather dark yellow-brown, spinulose, 9-11 µm diam. (Figure 2).

Figure 2. *Diderma deplanatum*: a- stereomicroscopic image of the sporangium, b- light microscopic image of the capillitium and spores.
Locality: Across from the Faculty of Arts and Sciences on debris, 36°19’39”N, 36°11’46”E, 119 m, 23.12.2010, Baba 12.

15. *Didymium difforme* (Pers.) S.F.Gray

Above Alahan village in coniferous woods, 36°19’55”N, 36°11’05”E, 350 m, 06.11.2010, Baba 47. In front of Faculty of Agriculture on debris of *Pinus* sp., 36°19’30”N, 36°11’45”E, 122 m, 22.12.2010, Baba 34, 78. Across from the Faculty of Medicine on debris of *Pinus* sp., 36°20’08”N, 36°11’54”E, 113 m, 30.12.2010, Baba 22, 58.


Syn.: *Didymium eximium* Peck; *Didymium fulvellum* Massee; *Didymium nigripes* var. *eximium* (Peck) A.Lister; *Didymium discoideum* K.S.Thind & H.S.Sehgal.

Fructifications sporangiate, stalked, sporocarps gregarious, up to 1.8 mm tall. Sporangia scattered, depressed-globose, discoid, usually umbilicate above and below, often sub-annulate or lobate, bluntly conical, white to ochraceous or pale grey, 0.4-0.7 mm in diameter. Peridium membranous, single, thin, often yellowish or ochaceous brown beneath the lime, rather sparsely clothed with yellowish or white lime crystals; stalk slender, cylindrical, striate, pale yellow-brown to orange, translucent except at the base, which is usually darker, somewhat calcareous, yellow, blackish at base with refuse matter; hypothallus prominent, discoidal; columella stalked, prominent, subglobose to discoid, dull yellow to orange-brown, rough or spiny above; capillitium arising from spines when these are present, scanty, threads slender, sparsely branched, flexuous, pallid or smoky, reticulate; spore-mass deep brown-pale purple brown, black in transmitted light, globose, spores violaceous brown, minutely warted to nearly smooth, 8-10 (-12) µm diameter (Figure 3).

Locality: In front of Faculty of Agriculture at bottom of *Populus* sp., 36°19’30”N, 36°11’45”E, 122 m, 18.12.2010, Baba 9.


Zülüflühan Cemetery among debris, 36°19’00”N, 36°11’30”E, 130 m, 23.12.2010, Baba 10.


Opposite the Faculty of Medicine on the body of *Pinus* sp., 36°20’08”N, 36°11’54”E, 113 m, 26.12.2010, Baba 15.

Figure 3. *Didymium megalosporum*: a- stereomicroscopic image of the sporangium, b- light microscopic image of the capillitium and spores.
Physaraceae

   In front of Faculty of Agriculture at bottom of maple, 36º19'30"N, 36º11'45"E, 122 m, 30.12.2010, Baba 78.

   In front of Faculty of Agriculture at bottom of maple, 36º19'30"N, 36º11'45"E, 122 m, 22.12.2010, Baba 34. Across from the Faculty of Arts and Sciences on debris, 36º19'39"N, 36º11'46"E, 119 m, 30.12.2010, Baba 24, 45.

   Anayazı village on debris, 36º19'00"N, 36º11'30"E, 130 m, 24.11.2010, Baba 7.

22. *Physarum leucopheum* Fr.
   Above Alahan village in coniferous woods, 36º19'55"N, 36º11'05"E, 350 m, 06.11.2010, Baba 42.

Stemonitales

Stemonitidaceae

   In front of Faculty of Agriculture at bottom of maple, 36º19'30"N, 36º11'45"E, 122 m, 26.01.2010, Baba 4.

   Above Alahan village in coniferous woods, 36º19'55"N, 36º11'05"E, 350 m, 06.11.2010, Baba 8.

   Above Alahan village in coniferous woods, 36º19'55"N, 36º11'05"E, 350 m, 06.11.2010, Baba 41.

   In front of Faculty of Agriculture at bottom of maple, 36º19'30"N, 36º11'45"E, 122 m, 29.12.2010, Baba 43. Above Alahan village in coniferous woods, 36º19'55"N, 36º11'05"E, 350 m, 06.11.2010, Baba 45.

   Across from the Faculty of Arts and Sciences on debris, 36º19'39"N, 36º11'46"E, 119 m, 01.11.2010, Baba 26.

28. *Comatrichia tenerrima* (Berk. & M.A.Curtis) G.Lister
   Anayazı village on debris, 36º19'00"N, 36º11'30"E, 130 m, 22.12.2010, Baba 35.

   Syn.: *Lamproderma cribrioides* sensu Kowalski.

   Sporangia dull purplish black, with metallic sheen but not iridescent, sporocarps stipitate, sessile or stalked sporangia are usually ovoid sometimes globose, forming small colonies, plasmodiocarpous. Stalk usually short, black and opaque; peridium is usually evanescent except for a basal cup and small fragments remaining attached to the capillitium, persistent, commonly iridescent and leaving a collar, outermost branchlets of capillitium often attached to peridial fragments by yellowish, funnel-shaped expansions, rest of peridium disappearing except at the base where it forms a cup; columella stout up to about mid-way, usually truncate and with most of the capillitium arising from the top; capillitium often radiating from the centre, frequently branched and sometimes anastomosed, usually with free ends at the periphery. Outermost branchlets of capillitium often attached to peridial fragments by yellowish, funnel-shaped expansions; spore-mass deep brown-pale purple brown, or black in transmitted light, globose, warty or partly to completely spiny-reticulate, 12-18 µm diameter (Figure 4).

   Locality: Near the Faculty of Science and Medicine on the twigs and leaves of *Eucalyptus* sp., 36º20'08"N, 36º11'54"E, 113 m, 16.01.2011, Baba 4.

   Above way to Alahan village under *Pinus* sp., 36º19'30"N, 36º11'45"E, 145 m, 14.10.2010, Baba 10.

31. *Stemonitis flavogenita* E.Jahn
   Above Alahan village in coniferous woods, 36º19'55"N, 36º11'05"E, 350 m, 06.11.2010, Baba 1.
32. _Stemonitis folicola_ Ing

In front of Faculty of Agriculture at foot of maple, 36°19’30”N, 36°11’45”E, 122 m, 26.01.2010, _Baba_ 1.

33. _Stemonitis fusca_ Roth

Alahan village in coniferous forest, 36°19’55”N, 36°11’05”E, 222 m, 25.06.2010, _Baba_ 8.

34. _Stemonitis herbatica_ Peck.

Above Alahan village in coniferous woods, 36°19’55”N, 36°11’05”E, 350 m, 06.11.2010, _Baba_ 22.

35. _Stemonitopsis amoena_ (Nann.-Bremek.) Nann.-Bremek.

Opposite the Faculty of Agriculture at bottom of maple, 36°19’30”N, 36°11’45”E, 122 m, 22.12.2010, _Baba_ 14. Above Alahan village in coniferous woods, 36°19’55”N, 36°11’05”E, 350 m, 06.11.2010, _Baba_ 12.

### Trichiales

#### Arcyriaceae

36. _Arcyria cinerea_ (Bull.) Pers.

Opposite the Faculty of Agriculture at bottom of maple, 36°19’30”N, 36°11’45”E, 122 m, 22.12.2010, _Baba_ 17. Above Alahan village in coniferous woods, 36°19’55”N, 36°11’05”E, 350 m, 06.11.2010, _Baba_ 3, 38.

37. _Arcyria denudata_ (L.) Wettst.

Above Alahan village in coniferous woods, 36°19’55”N, 36°11’05”E, 350 m, 06.11.2010, _Baba_ 6.

38. _Arcyria incarnata_ (Pers.) Pers.

Above Alahan village in coniferous woods, 36°19’55”N, 36°11’05”E, 350 m, 06.11.2010, _Baba_ 13.

39. _Arcyria minuta_ Buchet

Back of Sabanci residence on _Quercus_ sp. debris, 36°18’27”N, 36°11’58”E, 105 m, 20.10.2010, _Baba_ 5.
40. *Arcyria pomiformis* (Leers) Rostaf.
Near the Faculty of Arts and Sciences on debris, 36°19′39″N, 36°11′46″E, 119 m, 01.11.2010, Baba 26.

**Trichiaceae**

41. *Perichaena corticalis* (Batsch) Rostaf.
Opposite the Faculty of Agriculture at bottom of maple, 36°19′30″N, 36°11′45″E, 122 m, 31.12.2010, Baba 63.

42. *Perichaena depressa* Lib.
Opposite the Faculty of Agriculture under maple, 36°19′30″N, 36°11′45″E, 122 m, 01.11.2010, Baba 42.

43. *Perichaena vermicularis* (Schwein.) Rostaf.
Around the library on debris, 36°19′39″N, 36°11′46″E, 140 m, 24.12.2010, Baba 20.

Above Alahan village in coniferous woods, 36°19′55″N, 36°11′05″E, 350 m, 06.11.2010, Baba 12.

**Discussion**

Forty-four species belonging to 11 families of protostelionycetes and myxomycetes were identified in this investigation. Three species are new records for Turkey: *Diderma deplanatum*, *Didymium megalosporum*, and *Lamproderma atrosporum*.

In the study area, very rich myxomycete flora was observed. The climatic conditions are suitable for myxomycetes; a very dense flora in both species composition and frequency of myxomycetes was found. Twenty-two myxomycetes were collected in the field. As seen in several reports in the literature, naturally growing myxomycete fructifications are more common in the samples collected in rainy August and September. In fact, as pointed out in many studies, the frequency of myxomycetes from natural habitats is affected by climatic conditions, rainfall, and temperature.

*Echinostelium minutum*, *Arcyria cinerea*, and *Didymium difforme* are the most common species in our investigation but some species are only from certain substrates.

The most important features of *Diderma deplanatum* are stalk absent, columella absent or represented by thickened base, capillitial thread of one type, dark purple and elastic, often bearing nodular enlargement. Spores rather dark brown, finely spinulose, oblong to ring shaped plasmodiocarps.

The typical features of *Didymium megalosporum* are fructifications stalked, sporangia subglobose or umbilicate below, spores minutely warted or nearly smooth. Stalk slender, cylindrical, striate, pale yellow-brown to orange, peridium and capillitium has lime crystals. In our study the habitat and distribution of this species are similar to those of species known elsewhere in the world. Habitat is dead leaves and twigs; spore size range is 8-10 μm. According to Martin and Alexopoulos (1969), fructifications vary greatly in shape and the columella is also shaped like the contours of the fruiting bodies. According to Farr (1981), this rather uncommon species occurs on leaf litter and other plant debris mostly in the east. According to Hagelstein (1944), it seems to favour drier locations. The genus *Didymium* was collected from different substrates, such as *Abies* Mill., *Crataegus* L., *Juglans* L., *Juniperus* L., *Picea* Link, *Pinus* L., *Populus* L., *Quercus* L., *Sorbus* L., and *Ulmus* L. (Baba et al., 2008; Demirel & Kaşık, 2012); we collected this species from the bark of *Populus* sp.

*Lamproderma atrosporum* is stalked, black sporangia are usually ovoid, globose, forming small colonies, peridium is evanescent except for a basal cup and small fragments remaining attached to the capillitium. Capillitium is often attached to peridial fragments by yellowish, funnel-shaped expansions. Spores are warted-creticulate or spiny or partly to completely spiny-reticulate. According to Farr (1981), this is one of the western species, found in melting snowbanks in the mountains. We collected this species on the twigs and leaves of *Eucalyptus* sp.

With this study 3 new *Myxomycetes* were added to the myxobiota of Turkey and all of the species are recorded for the first time in Hatay.

**Acknowledgement**

This study was supported by Mustafa Kemal University Scientific Research Projects (BAP) (Project No: 1001 M 0113).
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