© by PSP Volume 30– No. 04/2021 pages 3565-3574 Fresenius Environmental Bulletin

NEW FOUR MYCETOZOA RECORDS FROM SOUTH EAST ANATOLIA-TURKEY

Hayri Baba[1,*], Mustafa Sevindik[2], Abdullah Er[1], Mine Atay[1], Yucel Dogan[1], Betul Altas[1], Hasan Akgul[3]

[1]Department of Biology, Faculty of Science and Art, Hatay Mustafa Kemal University, Hatay 31060, Turkey
[2]Department of Food Processing, Bahçe Vocational High School, Osmaniye Korkut Ata University, Osmaniye 80500, Turkey
[3]Department of Biology, Faculty of Science, Akdeniz University, Antalya 07058, Turkey

ABSTRACT

In this study myxomycetes samples was used as material and collected from the Southeastern Anatolia region of Turkey. The results of field and laboratory studies, four myxomycetes species identified to new record for Turkey. New records are; *Didymium decipiens* Meyl., *D. orthonemata* H.W. Keller & T.E. Brooks, *D. tussilaginis* (Berk. & Broome) Massee and *Hemitrichia aurea* Nann.-Bremek. & H. Neubert. *Hemitrichia aurea* sporocarps was found on the natural area. The other three species were grown in the laboratory by moist chamber culture method. As a result of natural and laboratory studies, four new records were listed below. Descriptions, habitats, localities, collection dates, fungarium numbers and images of the taxa was given.

KEYWORDS:
Myxomycetes, taxonomy, new records, Hatay, Batman, Turkey

INTRODUCTION

The myxomycetes (plasmodial slime molds) are eukaryotic microorganisms. They can be found, sometimes abundantly, in most terrestrial ecosystems, associated with plants and plant debris. Myxomycetes are phagotrophic amoeboid eukaryotes, a group of fungus-like organisms. The production of fruiting bodies and dispersal by spores, cause myxomycetes to appear similar to fungi. Temperature, moisture, pH and the availability of decomposing plant material are principal factors occurrence of myxomycetes in nature [1-3]. Their life cycle includes myxamoebae or swarm cells, multinucleate plasmodia and fruit bodies. There are four fruiting body types; sporangium, plasmodiocarp, aethalium and pseudoaethalium and a heterothallic Myxomycetes sporangium contains mainly six part. They live predatory on other microorganisms feed phagotrophically on bacteria, yeasts, spores of filamentous fungi, algae, and other protists. They inhabit microenvironments in forest ecosystems, such as the bark surface of living trees, forest floor litter and fallen trees decaying wood, forest floor litter, or the dung of herbivorous animals [4,5]. Myxomycetes consists of 1045 species worldwide [6]. The number of the myxomycetes in Turkey are 287 [7,8]. Aim of this study to identify myxomycetes of South East Anatolia and add to new record to Turkish myxobiota.

MATERIALS AND METHODS

Myxomycetes collected from different habitats of Hatay and Batman Province (Figure 1). Some samples obtained natural areas. But some species obtained with moist chamber culture technique in laboratory. For moist chamber culture technique; plant materials such as decaying woods, barks, leaves, debrises, animal dungs collected from different localities and moistened with distilled water in petri dishes. Sterile filter paper is laid on petri dishes and the collected substrates were placed. Distilled water was added and waited 48 hours in summer and 24 hours in winter. Samples were checked on a stereomicroscope every two days and the sporophore developments in the life cycle of the myxomycetes members were noted and have tried to obtain sporophore. The developed Myxomycetes were allowed to dry. Then, same chambers were remoistened for another 4 week period and analysis was performed as previously described. The identification of Myxomycetes members was done according to on the internet using online resources, theses, color atlases, and reference books [19-20]. Samples were arranged as fungarium material and kept in the Biology Department's laboratory of Mustafa Kemal University Hatay-Turkey.

RESULTS AND DISCUSSION

Short descriptions, habitats, localities, collection dates, fungarium numbers and images of the taxa was given. As a result of natural and laboratory studies, four new records was given below Table 1.

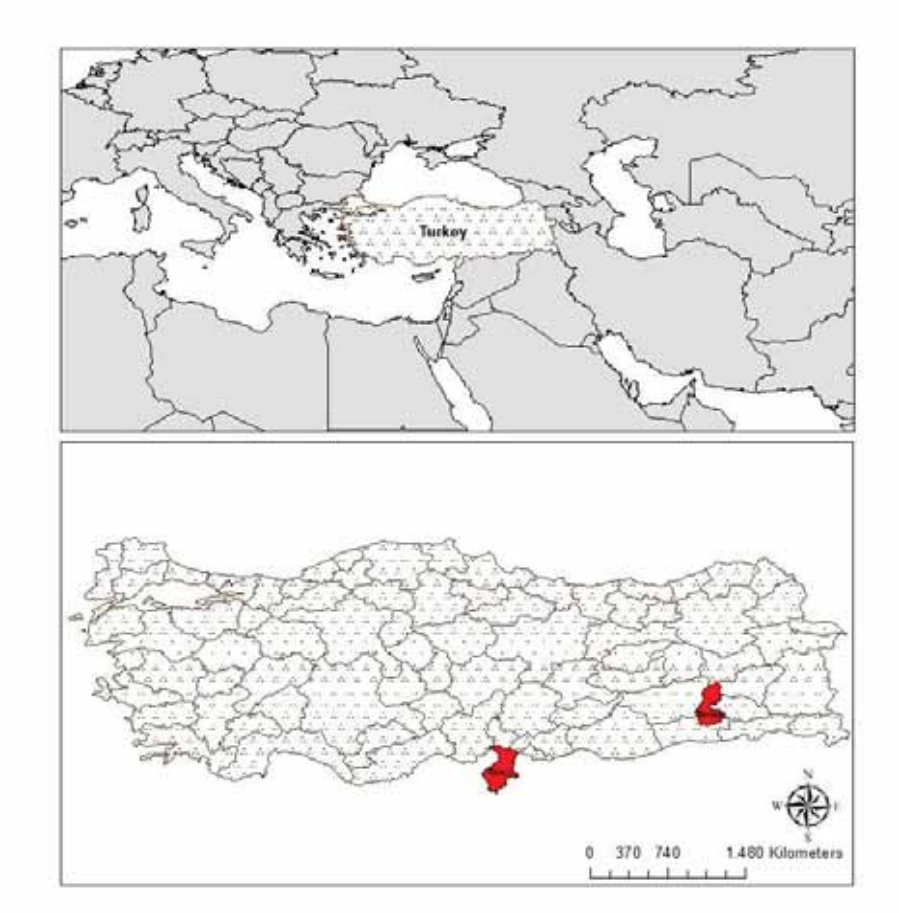


FIGURE 1
Map of research area

Domain: Eukarya
Regnum: Protozoa
Divisio: Amoebozoa
Subdivisio: Mycetozoa [20]

Descriptions of new records

Didymium decipiens Meyl., Bull. Soc. Vaud. Sci. Nat. 58:319 (1935)

Description: Fruiting bodies are plasmodiocarps, flat, thin, effuse, expanded, varying from dull grey, greyish white, black when the lime deposits are missing, to nearly white when it is more abundant. Hypothallus inconspicuous. Stalk and Columella absent. Peridium membranous, yellow-brown, dark greyish brown to blackish grey, iridescent, covered by sprinkled or encrusted with lime in the form of a few large and many small crystals of different sizes, but mostly as granules. Capillitium abundant, brownish, pale brownish yellow, composed of nearly straight or tortuous, sparsely branched threads 2-3 µm diam., slightly expanded at the attached bases and at the tips, magnifying glass, yellowish hyaline, with hyaline ends, where they are mostly attached to the peridium, bearing (1-) 3-4 closely wound spiral bands except at the smooth expanded ends, the threads sometimes spirally twisted about each other, filaments with tightly wound spiral bands, straight and parallel, sparsely branched and anastomosed, with funnel-shaped ends. Spore-mass black. Spores deep purplish brown, dark brown, densely warted or by SEM polyhedral to globose, subreticulate to reticulate, polyhedral with well-defined sides and the ornamentation formed by a reticulum of irregular meshes, sometimes incomplete, with non-perforated walls and more or less dented projections, globose or often ovate or elliptical in outline, 14-16 (-20) µm diam. Plasmodium unknown (Figure 2).

Comments: *D. decipiens* is characterized by plasmodiocarpous fructifications, with a dark peridium that turns white to grey due to the lime deposits, uniformly coloured capillitium formed by filaments ornamented with tightly wound spiral bands (that remind us of some species of the order Trichiida) and large, subreticulate to reticulate spores, 16-20 µm in diam., polyhedral with well-defined walls. *D. decipiens* the original diagnosis included no details of the external appearance, stating only that it was indistinguishable in that respect from *Didymium dubium* Rostaf. *D. dubium* further can be differentiated by smaller, globose (and not polyhedral) spores, 10-15 µm in diam., ornamented with baculae that are united by

TABLE 1
Identification keys of new record species

1. Spores borne internally, sporophore development is myxogastroid; can be stalked or sessile, can have capillitium and columella; there are calcareous nodes or calcareous internodes consisting of simple, branched, tubular strings; crystalline or granular lime deposits are mostly seen in sporophore or capillitium

Classis: Myxogastria

1.1. Lime present in some part of the fruiting bodies; stalk, columella, capillitium or peridium; plasmodium type is Phaneroplasmodium; spores violaceous-brown, deep purplish brown to black

Order Physarida

A. Capillitium not have calcareous deposits, capillitial threads are black or dark; calcareous deposits, when present, affecting the peridium only and there are stellate lime crystals, or sometimes on the stipe

Didymiidae

1. Fructification mostly sporangiate, sometimes plasmodiocarp, peridium contains stellate or angular lime crystals, capillitium not calcareous

Didymium

a. Spores densely and irregular spinulose, occasionally with ± conspicuous groups of slightly darker spines

b

a. Spores subreticulate to reticulate, polyhedral with well-defined sides and the ornamentation formed by a reticulum of irregular meshes, sometimes incomplete, with non-perforated walls and more or less dented projections

Didymium decipiens

b. Spores dark violet-brown, uniformly echinulate with spines to 1 µm high, 12-15 µm diam. Fructifications sometimes sporangiate but usually plasmodiocarpous

Didymium orthonemata

b. Spores pale brown to violaceous brown, with a wall of uniform thickness, without obviously lighter germination pore, densely and irregular spinulose, occasionally with ± conspicuous groups of slightly darker spines. Fructifications irregularly rounded, rarely oblong plasmodiocarps

Didymium tussilaginis

1.1. Lime absent from all parts of the fruiting bodies; plasmodium is Trichiaceus plasmodium types; spore mass more or less brightly colored, rarely pallid or light brown; spores white, orange-yellow, reddish, hyaline or light-colored

Order Trichiida

A. Capillitial threads form thick and distinct spiral bands, needles, thorns, ends are blunt or tapered or bifurcated, tubular capillitium, free or attached to the base of the sporocyst, often in a network

Trichiidae

1. Fruiting bodies sporangium or a plasmodiocarp, yellow, brown or almost black; peridium membranaceous, opening irregularly; stalk, if present, very short; capillitium net-shaped or of long to very long, brick red, free elaters

Hemitrichia

a. Fruiting bodies sporangium, sessile, clustered, globose to ovate, shining golden yellow to yellow-brown; peridium thin, transparent, the upper part wrinkled and without decoration; capillitium inelastic, sometimes triangular, meshes and numerous short, swollen, pointed, free ends; spores globose, yellow, broken reticulate

Hemitrichia aurea

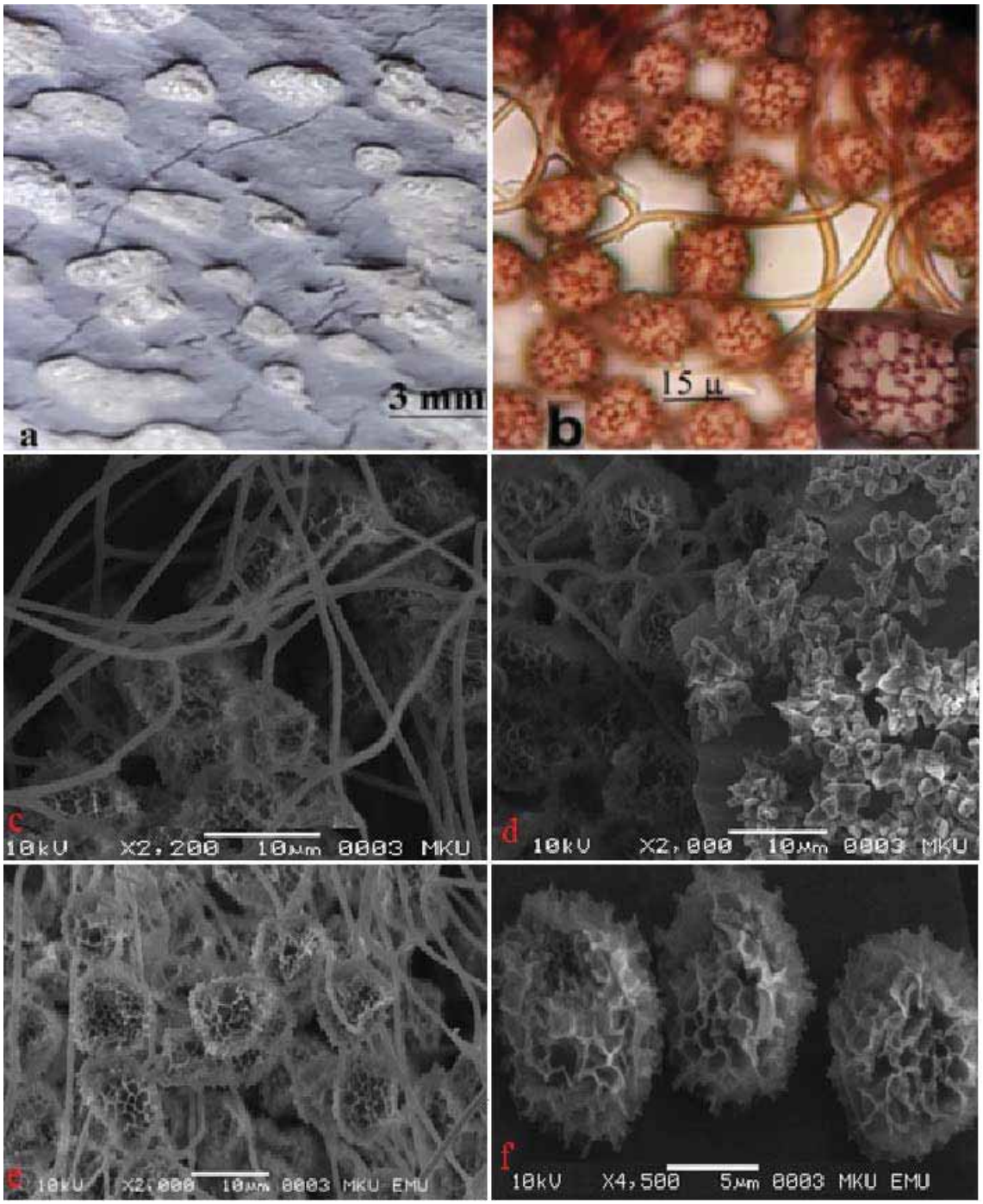


FIGURE 2

***Didymium decipiens* a) Plasmodiocarp b, c, d, e) Capillitium, stellate lime crystals and spores f) spores**

low walls forming an incomplete reticulum by SEM [21]. According to Martin and Alexopoulos [9], there are consistently three or four such bands, apparently attached both to the base and the peridium of the thin, expanded fructification, smooth only near the expanded bases and tips. The bands are exactly like those of a typical *Trichia* and the coiling of the elaters about one another suggests that feature as it appears in *Metatrichia vesparia* (Batsch) Nann.-Bremek. ex G.W. Martin & Alexop. except fort the lack of free, sculptured ends. This, and the large, very dark, strongly warted spores and, if our specimen is typical, the aberrant character of the lime, are the marks of this unusual species [9].

Specimens examined: Batman, city center, 37°52'10"N-41°07'38"E, 550 m., 01.10.2017, on filter paper and plastic petri dishes, Altaş, 9.

World distribution: Germany, Switzerland.

Didymium orthonemata H.W. Keller & T.E. Brooks, Mycologia 65(2):290 (1973)

Description: Fructifications gregarious to scattered, sessile on a broad base, pulvinate to

depressed, sometimes sporangiate but usually plasmodiocarpous, up to 5 mm across and 2 cm in length, about 0.08-0.2 mm thick, whitish to pale dull gray, purplish black when lime scanty. Hypothallus not apparent. Stalk absent. Columella lacking, the floor of the fructification slightly thickened, limeless, brown to purplish black. Peridium fragile, simple, membranous, hyaline, either densely encrusted with a continuous layer of crystalline lime, or sparsely sprinkled with lime in aggregates or clumps, lime crystals varying from irregular to stellate to nodular masses with projecting spicules, dehiscence irregular from above. Capillitium consisting of more or less straight, upright, coarse threads 1-4 µm in diam, smooth or sometimes roughened by small bumps in the mid-portions, usually hyaline but sometimes pale to dark purplish brown with hyaline extremities, rarely anastomosing in the mid-portions then often forming H-shaped threads, more or less parallel, extending from the base to the upper part of the peridium, in dehiscence usually breaking at the base and remaining persistently attached to the peridium. Spore-mass dark brown. Spores dark violet-brown, uniformly echinulate with spines to 1 µm high, 12-15 µm diam (Figure 3).

Comments: *D. orthonemata* is distinguished by its rather coarse, upright capillitial threads that seldom anastomose and by its strongly spinulose spores. Corticolous species growing and fruiting on the bark surface of living trees and vines. This species is very similar to *Didymium anellus* Morgan, except for the darker colour and larger size of the spores, which are 12-15 µm versus less than 11 µm in *D. anellus* [22]. Although this species lacks any particularly distinctive feature, its combination of characteristics does not agree with that of any of the presently accepted species of *Didymium*. From the typically stalked species of the genus which on occasion form plasmodiocarpous fructifications, *D. orthonemata* is distinctive. In spore characteristics it is most similar to *Didymium melanospermum* (Pers.) T. Macbr., but differs also in the consistent lack of a prominent, calcareous columella. From plasmodiocarpous phases of *Didymium squamulosum* (Alb. & Schwein.) Fr. & Palmquist it differs in the larger, darker spores. Among the plasmodiocarpous species, *D. orthonemata* has some superficial resemblance to *Didymium sturgisii* Hagelst., but lacks the trabecular perforations. The spores also tend to be larger and are darker and more

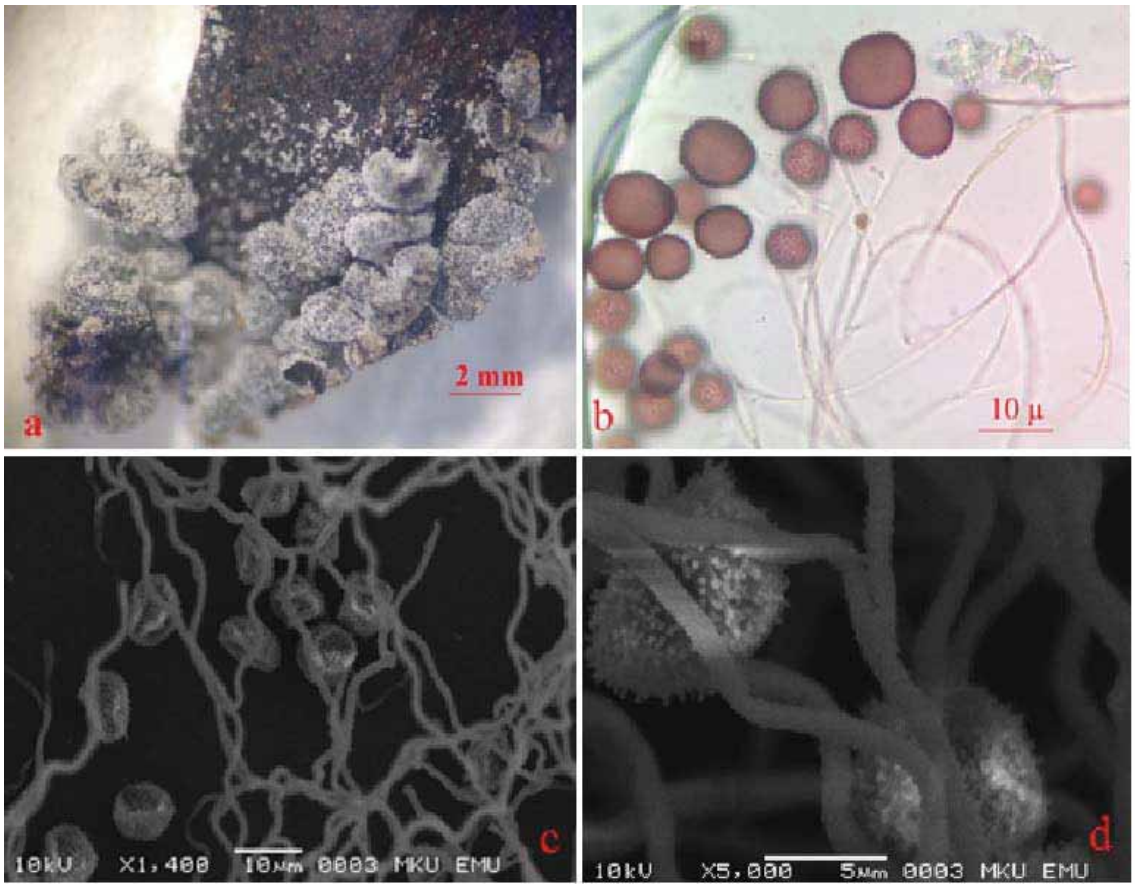


FIGURE 3
Didymium orthonemata **a) Sporophores b, c, d) Spores, stellate lime crystals and capillitium**

strongly ornamented. This species is perhaps most closely related to *D. dubium*. The latter species has an abundant capillitium with threads freely anastomosing by nearly transverse bars to form an elastic net separating readily from the base and peridium in dehiscence, and spores paler and smoother on one side. In *D. orthonemata* the capillitium is scanty, seldom anastomosing, and persistent to the peridium in dehiscence, and the spores are uniform in color, lacking a paler area. In any case, spore ornamentation differs markedly and distinguishes *D. dubium* from *D. orthonemata*. In the former species the spores are minutely to strongly warted, the warts irregularly distributed and tending to be fused at their bases into curved lines or form a distinctly subreticulate pattern; in the latter species spores are uniformly and conspicuously spiny with no evidence of a subreticulate pattern. Range in spore size overlaps in the two species but is consistently larger in *D. orthonemata* [18, 23].

Specimens examined: Hatay, Reyhanlı-Konuk, 36°15'27"N-36°26'16.2"E, 97 m., 04.04.2015, on debris, Atay, 13.

World distribution: Mexico, USA

Didymium tussilaginis (Berk. & Broome) Massee, Monogr. Myxogastr. 244 (1892)
Syn: *Physarum tussilaginis* Berk. & Broome
Diderma tussilaginis (Berk. & Broome) Kuntze

Description: Sporocarps irregularly rounded, rarely oblong plasmodiocarps, light grey, often conspicuously flat, sessile on a broad base, 0.2-0.4 mm tall, 0.4-1.5 (-2.5) mm wide, scattered or in loose groups, sometimes growing in groups of 5-25 sporocarps. Hypothallus conspicuous, whitish to beige, common to a group of adjacent sporocarps, but aggregated hairs of lower leaf surface of the host plant appear like a larger extended hypothallus. Stalk absent. Columella inconspicuous, but mostly appearing as a clearly distinct, thin, chalky base, white, dirty white to beige, slightly shiny, sometimes with humplike outgrowths or short ridge-like elevations. Peridium simple, membranous, under the

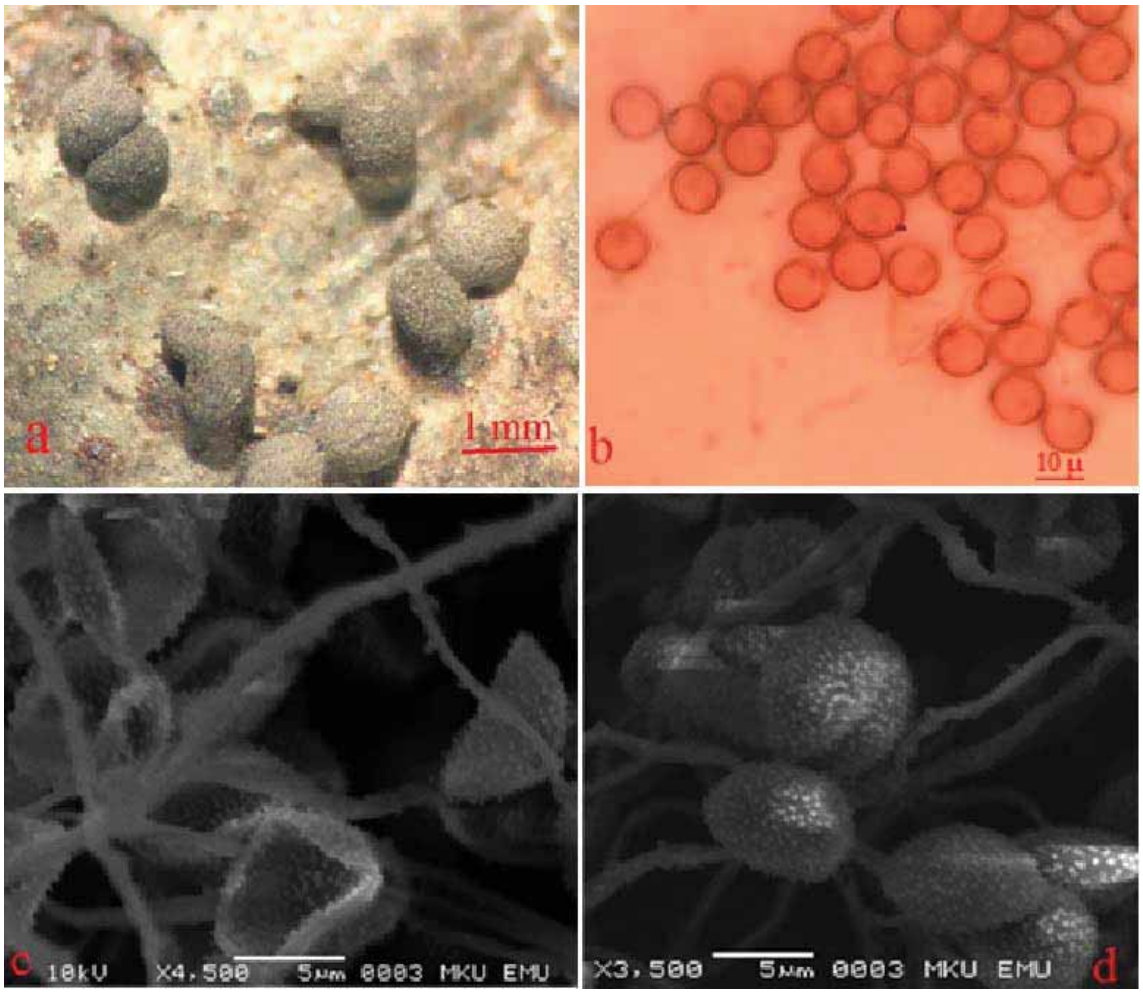


FIGURE 4
Didymium tussilaginis **a) Sporangium b, c, d) Spores, stellate lime crystals and capillitium**

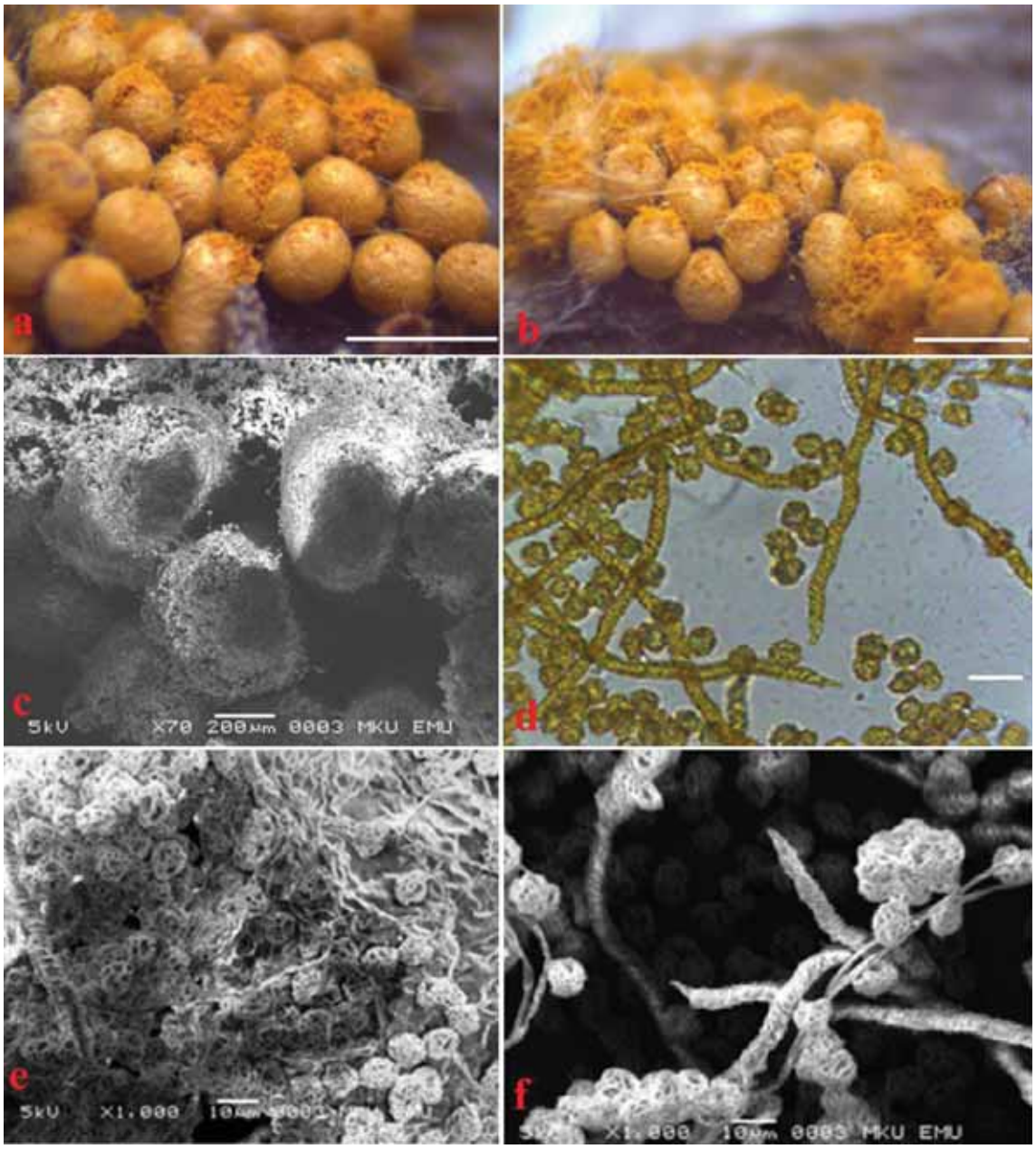


FIGURE 5
Hemitrichia aurea **a, b, c) Sporangium d, e, f) Spores and capillitium**

magnifying glass mostly with metallic, sometimes light blue iridescent, under transmitted light almost translucent, very pale brown or pale yellow, usually only sparsely covered with calcareous scales, these fine crystalline or mostly amorphous with irregular, angular shape, 5-20 (-30) µm in size. Capillitium whitish under the lens, almost colorless in transmitted light or pale brown, rarely darker brown, irregularly branched or sometimes reticulate, often with small inclusions of crystalline or amorphous calcium, 0.6-3 (-5) µm in diameter, somewhat elastic, mostly smooth, some threads with darker swellings. Spores free, in mass dark brown, by transmitted light pale brown to violaceous brown, with a wall of uniform thickness, without obviously lighter germination pore, densely and irregular spinulose, occasionally with ± conspicuous groups of slightly darker spines, spores spherical, 12-13 (-15) µm or slightly ovoid 12-14 (-16) x (10-) 11-13 µm. Plasmodium dark lilac to grey (Figure 4).

Comments: Sporangia sessile on a broad base, hemispherical or irregular, sporocarps or plasmodiocarps, with minute, scattered crystals of lime, dehiscing irregularly. Peridium thin, membraneous, rather fragile, hyaline with scattered very pale brownish, almost colourless, on the outside with scattered, angular lime crystals. Columella none. Capillitium parallel, thin threads, sparsely branched, dichotomously, sometimes with expansions apparently containing crystalline or amorphous granules, radiating from base to

peridium, hyaline to pale brownish well developed, threads. Spores globose to slightly irregularly shaped, dark brown, medium greyish brown, occasionally slightly paler on one side, with medium dense, regularly distributed short spines, very minutely verruculose or quite smooth. *D. tussilaginis* is closely related to *Didymium vernum* Kuhnt, K. Baumann & Nowotny. Macroscopically they differ by the grey sporocarps of the former versus brown sporocarps of the latter. Microscopically *D. tussilaginis* has clearly larger spores than *D. vernum*. *D. tussilaginis* is characterized by grey, flat fruiting bodies with scattered lime crystals on the peridium surface, small calcareous inclusions in the capillitium and finely spinulose spores. At some locations this species could be observed in large amounts. *D. vernum* has very prominent, large, orange-brown lime crystals at the peridium, which is sometimes weakly mottled in transmitted light. *D. vernum* is less common than *D. tussilaginis* and the collections usually contain fewer sporocarps. Two collections of an unknown species are presented as *Diacheopsis* sp., both are characterized by a dark reddish-brown hypothallus and unusual, yellow, oil droplet-like inclusions in the spores of freshly collected specimens. It is assumed that plasmodium develops in the soil and passes to the folded leaves before it sprouts on the soil surface [24].

Specimens examined: Hatay-Antakya-Batıayaz, 36°10'02"N-35°59'29"E, 478 m., 21.12.2013, on fruit of Carob, Doğan 29.

World distribution: Austria, Denmark, France, Germany, Netherlands

Hemitrichia aurea Nann.-Bremek. & H. Neubert, in Neubert & Nannenga-Bremekamp, Z. Pilzk. 42(A):33 (1976)

Syn.: *Hyporhamma aureum* (Nann.-Bremek. & H. Neubert) Lado

Description: Fruiting bodies sporangium, round and oval, sessile, clustered, globose to ovate, shining golden yellow to yellow-brown, 0.5-1.4 mm diam. Stalk and Columella absent. Peridium thin, transparent, the upper part wrinkled and without decoration, the lower part irregularly verrucose. Capillitium inelastic, forming an intricate net with small, sometimes triangular, meshes and numerous short, swollen, pointed, free ends, 10-15 µm long, with 4-5 mostly smooth, spiral bands with occasional spines, with longitudinal striae, the basal tubules 3 µm diam., wider above 5-7 (-10) µm diam. Sporemass golden yellow. Spores globose, yellow, 11-13 µm, broken reticulate, 1 µm high. Plasmodium unknown (Figure 5).

Comments: *H. aurea* sporangium is round and oval, sessile, clustered, shining golden yellow. Peridium thin. Capillitium inelastic, forming an intricate net with small, sometimes triangular, meshes and numerous short, swollen, pointed, free ends. Spores globose, yellow, broken reticulate. The genus *Hemitrichia* is characterized by having tubular capillitial threads which are entangled more or less completely into an elastic net, and are marked with 2-5 spiny or smooth spiral bands. Here associated are intermediate between *Arcyria* and *Trichia*, resembling the former in the capillitial net and the latter in thread-sculpture. Consisting of 7 species in Turkey. *H. aurea* similar to rare species *Hemitrichia chrysospora* (Lister) Lister, whose spores are gross, has a periodically owned network drawing with narrow, uninterrupted on randern, the scalp is thinner and free of spines, the peridium is densely covered with wart. Scalp and spores indicate a close relationship with the group around *Trichia favoginea* (Batsch) Pers. capillitium a much-branched, non-elastic network with small, sometimes triangular mesh angles, plenty of free, short-pointed, in front of the tip sometimes thickened, with 4-5 tightly wound spiral afford with fine [17].

Specimen examined: Hatay, Belen, Atik plateau, 36°30'35"-N 36°13'15" E, 854 m, 12.02.2019, on dead wood of *Pinus brutia* Ten., natural, Baba, 229; Hatay, Şenbük, 36°26'07" N 36°14'38" E, 204 m, 12.02.2019, on dead wood of *P. brutia*. natural, Er, 297.

World distribution: Germany

CONCLUSIONS

As a result of this study 4 new myxomycetes record contributed to Turkish myxobiota. Currently, 287 species in Turkey has been identificated. With this study increased to *Didymium* and *Hemitrichia*. As a result, the number of myxomycet species in Turkey was increased to 291 by this study. These new records was *D. decipiens*, *D. orthonemata*, *D. tussilaginis* and *H. aurea*.

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Received: **16.10.2019**
Accepted: **27.12.2020**

CORRESPONDING AUTHOR

Hayri Baba
Department of Biology,
Faculty of Science and Art,
Hatay Mustafa Kemal University,
Hatay 31060 – Turkey

e-mail: hayribaba_68@hotmail.com