

Two interesting species of *Tulostoma* from the Mediterranean Basin

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Abstract: *Tulostoma scrupososporum* is proposed as a new species and *Tulostoma jourdani* is recorded again in the Mediterranean Basin. Both species are described macro- and microscopically, and the most important features are illustrated, including microphotographs of the spore ornamentation in the scanning electron microscope.

Zusammenfassung: *Tulostoma scrupososporum* wird als neue Art vorgeschlagen, und *Tulostoma jourdani* wurde neuerlich im Mittelmeergebiet gefunden. Beide Arten werden makro- und mikroskopisch beschrieben und die wichtigsten Merkmale werden in SW-Fotos dargestellt, inklusive SEM-Aufnahmen der Sporenoberfläche.

Northern Africa can still be considered as a very interesting geographical area from the mycological point of view. Except the great expeditions in the past, realized fundamentally by French scientists, few or very sporadic contributions have been done in this respect. The fungi that grow in these xeric areas are adapted to, usually, tough and selective environmental conditions, with rather scarce rainfall, poor soils and with a hardly developed plant-cover. Considering also the great dimensions of these areas and the arduousness of collecting material in them, it is still likely to find undescribed or poorly known taxa despite the fact that fungal diversity is not so high as in other more temperate and moist areas with forests.

Since some years we are studying the Gasteromycetes growing in Mediterranean areas, including the mentioned North African territory. Several contributions have resulted from these studies, fundamentally in the *Tulostomatales* (ALTÉS & MORENO 1991, MORENO & al. 1992, WRIGHT & al. 1993). During a trip of one of us (A. HAUSKNECHT) in Morocco in 1989, some species of fungi, which were included in a previous paper (HAUSKNECHT 1991), were collected. Among them there are some collections of *Tulostoma* that have been studied again and proved to be more interesting than we first thought. After studying the descriptions of the known *Tulostoma* spp. (WRIGHT 1987) and the types of the most similar species, we decided to describe our material as a new species: *Tulostoma scrupososporum*.

The Near East is another interesting region in the Mediterranean Basin whose mycoflora is still poorly known. Here we add a new record of *Tulostoma jourdani* PAT. from Jordan, a xerophilous species which is difficult to separate from others without studying the spore ornamentation in SEM, as pointed out by WRIGHT (1987).

Material and methods

Scanning electron microscope (SEM) study of spores was made with a Zeiss DSM-950. The spores were rehydrated with 50% ammonium hydroxide, fixed in 3% glutardialdehyde in water for 24 h, dehydrated in an ethanol series (70%, 80%, 90% and 96%) for 15 min each, and thereafter immersed in acetone for 2 h at least. Then, the spores were critical point dried, deposited on aluminium stubs, and coated with gold-palladium in a Polaron E-5000 sputter coater. A Nikon Labophot was used for routine light microscope (LM) study. In this case, the samples were viewed in 5% ammonium hydroxide or ammoniacal congo red solution 1%.

The colour of the gleba was determined following LOCQUIN (1975).

The material studied is deposited in A. HAUSKNECHT's personal herbarium, in the Herbarium of the University of Vienna, Austria (WU), or in the Herbarium of the University of Alcalá de Henares, Spain (AH).

***Tulostoma scrupososporum* ALTÉS, MORENO & HAUSKNECHT, spec. nova** (Figs. 1-10, 17)

Misinterpret.: *Tulostoma fimbriatum* s. HAUSKNECHT 1991 in Boll. Gruppo Mycol. Bresadola **34**: 159.

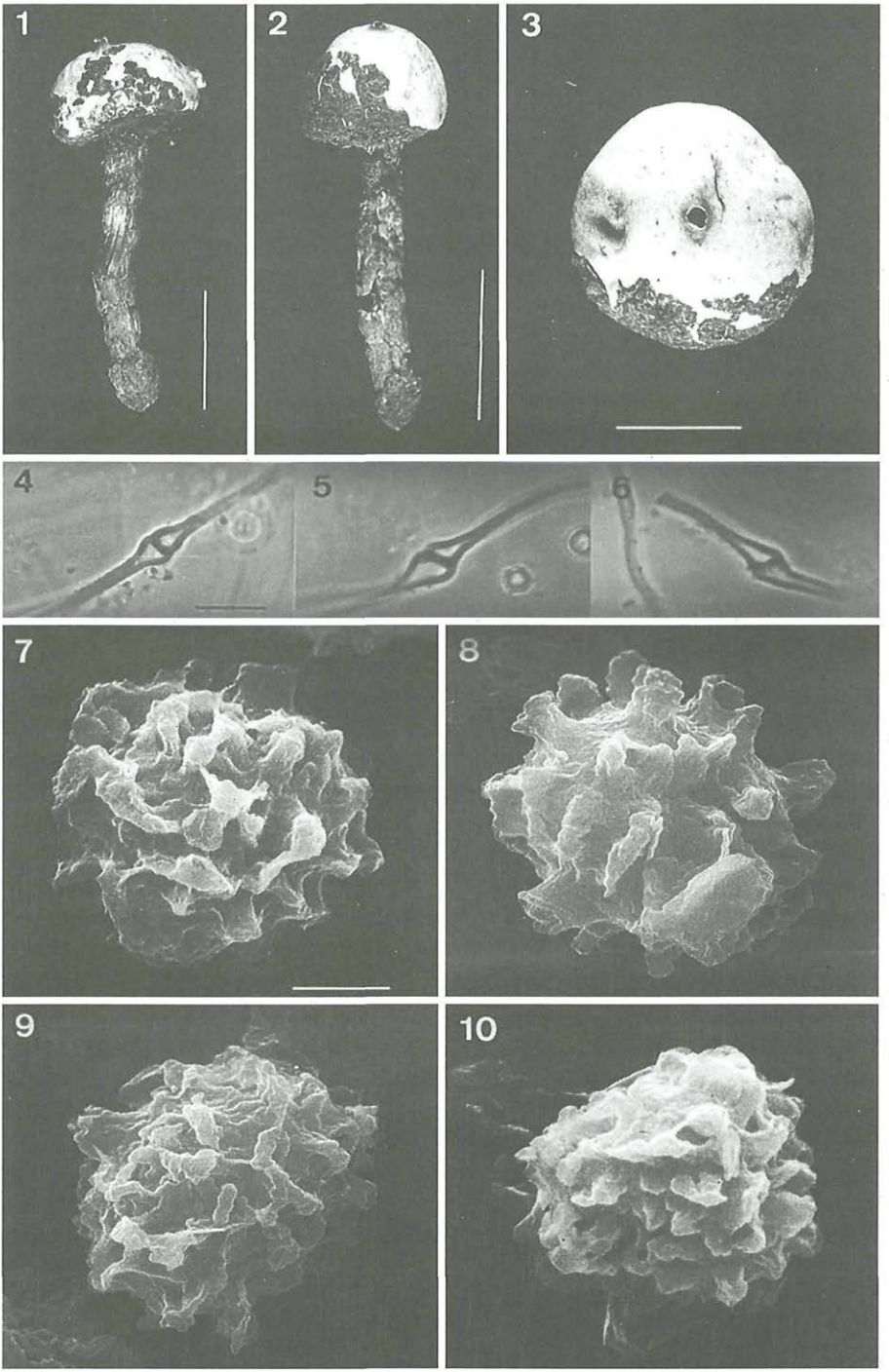
Sacculo sporifero 9-14 x 6-8 mm, subgloboso. Exoperidio proprie membranoso, brunneo-rubro extra et albo intus. Endoperidio albo et laevi. Ore tubulari, 0,5-1 mm longo, 0,5-1,5 mm lato. Gleba ocraceo-ferruginosa. Stipite 20-23 x 2-3 mm, castaneo-brunneo, rugoso-fibroso.

Sporis globosis vel subglobosis, 5-7 µm diam., flavis, proprie verrucosis cristas saepe efformantibus. Per microscopium electronicum cristae manifeste apparent. Capillitio hyalino vel flavo, 3-9 µm lato, parietibus crassitunicatis, septato, septis incrassatis et hyalinis (7-9 µm lato).

Typus: Morocco, Taroudant, foot-hills of Haut Atlas, Tamaloukt, on sandy soil with plant remains, 2. 12. 1989, leg. A. HAUSKNECHT (WU 8158). Isotypus: AH 16676.

Etymology: The name refers to the coarse and gross ornamentation of spores.

Basidiocarps 26-43 mm long including the spore-sac. Spore-sac 9-14 x 6-8 mm, subglobose to depressed. Mouth tubular, 0.5-1.5 mm diam. and up to 1 mm long, peristome sometimes darker than the endoperidium. Exoperidium typically membranous, reddish brown outside and white inside, persistent especially at the base of the spore-sac. Endoperidium membranous, dirty white to cream, at first covered with farinaceous remains of the exoperidium, later smooth. Gleba ferrugineous (LOCQUIN 1975: phaeotus J2g). Stem 20-23 x 2-3 mm, brown, cylindrical, slightly broadened at the base up to 3-3.5 mm, rugose-fibrous, with thick scales. Socket limited by a membranous lacerate-dentate collar, reddish brown.



Figs. 1-10. *Tulostoma scrupososporum*. - 1. Basidiocarp showing the tubular mouth and the membranaceous remains of the exoperidium, Herb. HAUSKNECHT. - 2, 3. Basidiocarp and detail of the spore-sac of the holotype, WU 8158. - 4-6. Light micrographs of capillitium septa of the holotype. - 7-10. SEM micrographs of the spore ornamentation of the holotype. Bars: Figs. 1, 2: 1 cm, 3: 0.5 cm, 4-6: 15 µm, 7-10: 2 µm.

Exoperidium consisting of hyphae of 2-4 µm diam., interwoven, tortuous, walls rather thin, branched, not broadened at the septa, no clamps seen. Endoperidium consisting of hyphae of 3-7 µm diam., closely interwoven, walls thick, branched, usually broadened at the septa (up to 10 µm diam.), no clamps seen. Spores globose to subglobose, 5-7 µm diam., pale yellow, with coarse ornamentation of big warts sometimes joined forming gross crests; in SEM the presence of the mentioned crests can be clearly observed, being fairly variable in shape and size. Capillitium hyphae 3-9 µm diam., walls thick, lumen visible, branched, septate, broadened at the uncoloured septa up to 7-9 µm diam.

Material studied (besides holotype): *Tulostoma scrupososporum*: Morocco, Taroudant, Anti-Atlas near Tiningmouten, 4. 12. 1989, leg. A. HAUSKNECHT (Herb. HAUSKNECHT); - Anti-Atlas, Azour, Tifnout, 6. 12. 1989, leg. A. HAUSKNECHT (WU 8157); - foot-hills of Haut Atlas, near Ouled Berrehill, 7. 12. 1989, leg. A. HAUSKNECHT (Herb. HAUSKNECHT).

T. brasilense J. E. WRIGHT: Argentina: Misiones, Garuhapé, leg. GÓMEZ, DEL BUSTO & LEVIN, 29. 7. 1964, BAFC 29246.

T. montanum PAT.: Algeria, Tebessa-Bou Chebka, Jan.1893, FH (Herb. PATOUILLARD), type.

T. subsquamosum LONG & AHMAD: India, Gurdaspur, Aug. 1938, BAFC (Herb. AHMAD 258), isotype.

T. macalpinianum LLOYD: Australia: Melbourne, leg. MCALPINE, BPI (Herb. LLOYD 4504), type.

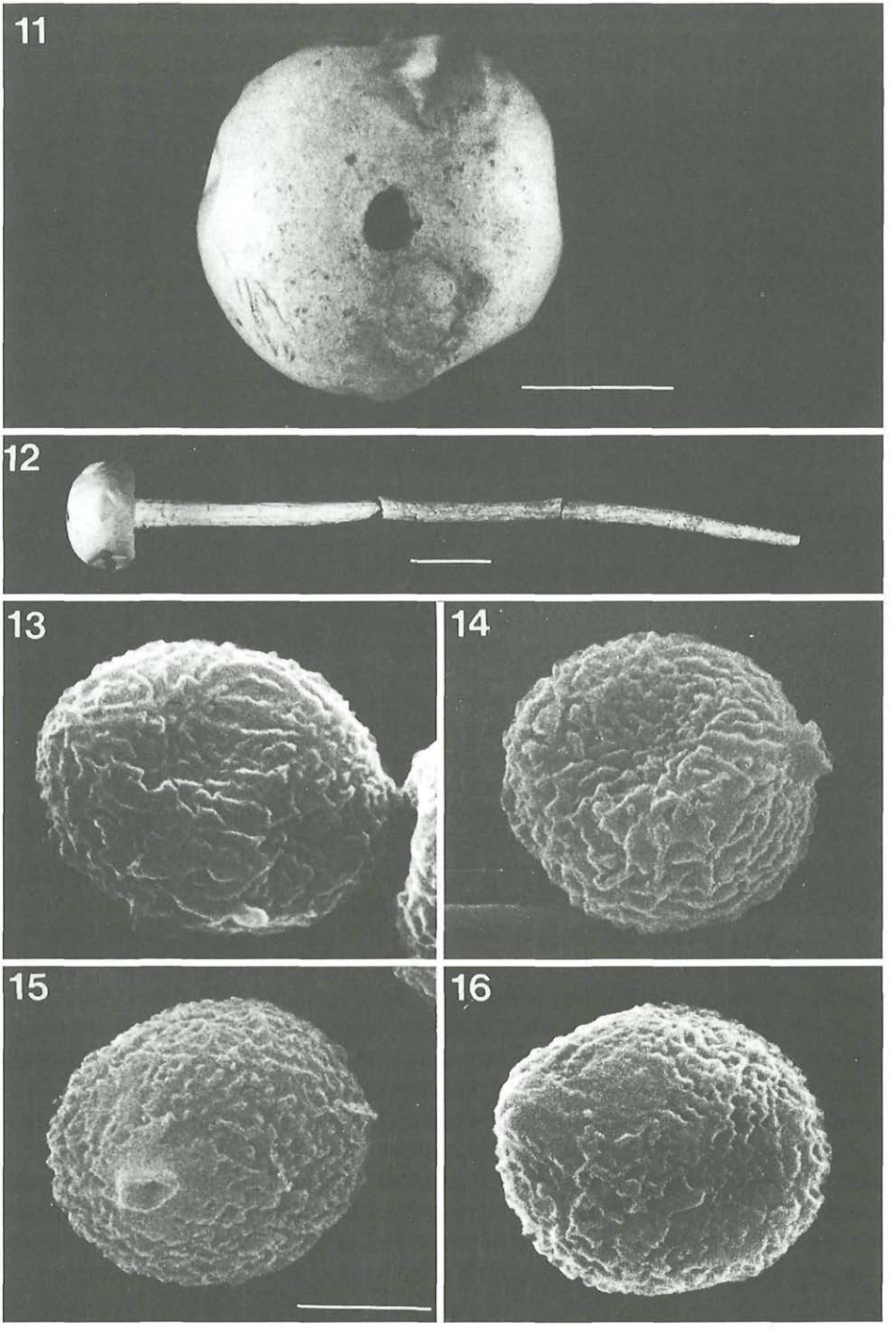
T. involucratum LONG: USA.: New Mexico, Luna Co., Dening, leg. LONG & STOUFFER, 13. 9. 1941, BPI (Herb. LONG 9650), type.

Remarks. *Tulostoma scrupososporum* is characterized by its exoperidium which is clearly membranous, reddish brown and persistent at the base of the spore-sac; its well developed tubular mouth; and its rather big spores, ornamented with gross warts sometimes forming crests. It is similar to *T. brasiliense* J. E. WRIGHT, *T. montanum* PAT., *T. subsquamosum* LONG & AHMAD, *T. involucratum* LONG, and *T. macalpinianum* LLOYD. However, these species can be distinguished easily by the following characters: *T. brasiliense* has a coloured endoperidium and its spore ornamentation is not so coarse; the exoperidium of *T. montanum* is not so typically membranous, its endoperidium is coloured and its spores have thinner warts, which usually form crests (MORENO & ALTÉS 1992); the exoperidium of *T. subsquamosum* is not so typically membranous, its spores are smaller (4.6-6.1 µm diam.) and its spore ornamentation consists of warts and spines joined showing the aspect of a labyrinth; the mouth of *T. involucratum* is wider (2-3 mm diam.), its spores are smaller [4-5(-5.5) µm diam.] and have less coarse ornamentation; the spore-sacs of *T. macalpinianum* seldom exceed 10 mm diam., and its spore ornamentation is poorly developed.

Tulostoma jourdani PAT., Rev. Mycol. **8**(30): 143-146, 1886 (Figs. 11-16)

Basidiocarp 88 mm long including the spore-sac. Spore-sac 13 x 8 mm, subglobose-depressed. Mouth circular and plane, not fimbriate, 2 mm diam. Exoperidium absent, only remaining a few hyphae intermingled with sand grains at the base of the spore-sac. Endoperidium papyraceous, greyish ochre, smooth. Gleba ferrugineous (LOCQUIN 1975: phaeotus J2f). Stem 80 x 3 mm, slightly tapering downwards, dirty white and longitudinally striate at the apex, covered by some concolorous scales which become more abundant and slightly darker downwards. Socket conspicuous, limited by a white membranous collar with the edge unevenly festooned.

Endoperidium consisting of hyphae of 1.5-3 µm diam., very interwoven, walls thick, lumen scant, branched, broadened at the frequent septa up to 4 µm diam. Spores



Figs. 11-16. *Tulostoma jourdani*. - 11, 12. Basidiocarp and detail of spore-sac showing its circular and plane mouth, WU 12661.- 13-16. SEM micrographs of the spore ornamentation. - 13, 14. WU 12661; - 15. AH 15592; - 16. Isotype, PC. Bars: Fig. 11: 0.5 cm, 12: 1 cm, 13-16: 2 µm.

Fig. 17. *Tulostoma scrupososporum*. - Holotype, WU 8158.

globose to subglobose, 4-6 µm diam., pale yellow, smooth in LM; however, in SEM they show a typically rugose surface. Capillitium 2.5-6 µm diam., subhyaline, branched, walls thick, broadened at the scant and coloured septa up to 8-9 µm diam.

Material studied: Jordan, Vadi Rum, 60 km from Aqaba desert, in sand, 1000 m s. m., 5. 5. 1990, leg. E. KÖRBER (WU 12661). - Algeria, El Goleah, Feb. 1880, leg. M. CHOISY (PC, isotype). - Mexico: Baja California, Bahía de los Angeles, 15. 9. 1992, leg. F. VALVERDE & E. NAVA (BCMEX 4736 and AH 15592).

Remarks. *Tulostoma jourdani* is characterized by its circular and plane mouth, its hyphal exoperidium, its scantily septate capillitium, and especially by its spores which are smooth in LM but rugose in SEM. In the specimen described only a few hyphae of the exoperidium are left. Further, the long stem is remarkable. *T. jourdani* can be easily mistaken for other species with smooth spores; therefore, a SEM study of the spores is necessary in order to confirm the identification. In Figs. 13-16 the spores of the material from Jordan are compared with the type from Algeria, and with a collection from Mexico, showing that the fine rugulose surface is a constant character. *T. jourdani* has been recorded from subarid areas of North America, South America, Africa, Asia and Australia (WRIGHT 1987). It seems to be very likely that this species also grows in southern Europe and that some misidentified collections exist in diverse herbaria.

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