

NOTES ON TYPE MATERIALS OF TULOSTOMA (TULOSTOMATACEAE)
T. macrosporum, T. meridionale and T. utahense

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A study of the macroscopic and microscopic characters of type materials of *Tulostoma macrosporum*, *T. meridionale* and *T. utahense* is presented. The synonymy of the two latter species, that was proposed some years ago, is now verified. *Tulostoma macrosporum* is very close to them, but shows enough differential features to be maintained as an autonomous species. SEM photographs of the spore ornamentation are provided.

This report is a continuation of a series of studies on type materials of species described in the genus *Tulostoma* Pers.: Pers. in an attempt to resolve some taxonomic problems. It is relatively frequent in this genus to find species named with different epithets in various geographical areas, which increases very much their apparent number. We have already demonstrated some of these synonymies, based principally on the study of the spore ornamentation under SEM, in other papers: Altés & Moreno (1993, 1995), Moreno et al. (1992, 1995, 1997), Altés et al. (1999). We thus believe it is feasible to reduce the number of specific epithets of *Tulostoma* to a more realistic level.

In the present paper we compare the types of three species with very similar macroscopic characteristics and spores greater than 6.5 µm diameter (exceptional in the genus), to clarify their possible synonymy: *Tulostoma macrosporum* G. Cunn. (Cunningham, 1925) from Australia, and *T. meridionale* J.E. Wright (Wright et al., 1972) and *T. utahense* J.E. Wright (Wright, 1987) from the USA. The author of the two latter species already mentioned their great similarity and their possible synonymy (Wright, 1987). Later, this synonymy was proposed by Moreno et al. (1995) based on several Mexican collections and literature.

MATERIALS AND METHOD

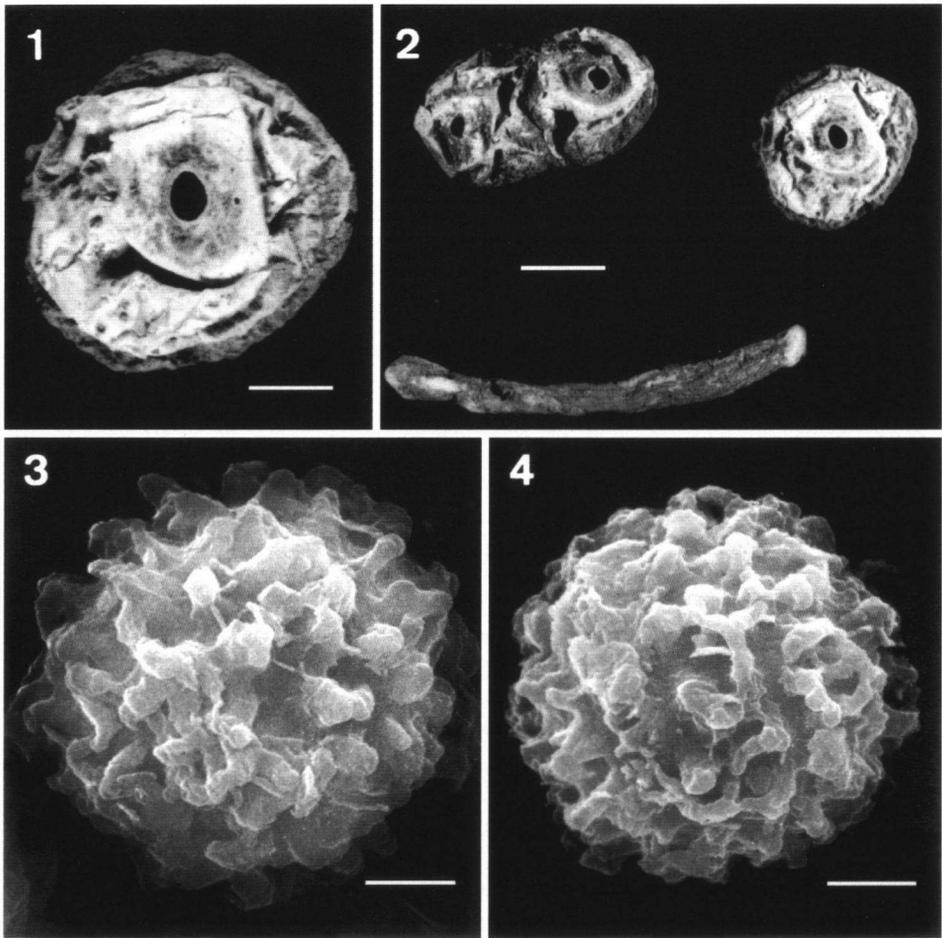
The studied type materials are deposited in the State Herbarium of South Australia, Adelaide, Australia (AD), the National Fungus Collections, Beltsville, Maryland, USA (BPI), and the New York Botanical Garden, New York, USA (NY).

Photographs using scanning electron microscopy (SEM) were made following Moreno et al. (1995).

1. *Tulostoma macrosporum* G. Cunn. — Figs. 1–4

Tulostoma macrosporum G. Cunn., Proc. Linn. Soc. New South Wales 50 (1925) 252.

The holotype collection is made up of five basidiocarps, two of them united laterally (Fig. 2); the stems are separated and fragmented in all the basidiocarps, excepting one,



Figs. 1–4. *Tulostoma macrosporum*, holotype (AD 17278). 1. Detail of a spore-sac with its slightly tubular mouth and some adhering remains of the exoperidium; 2. spore-sacs, two of them laterally united, and a separated stem; 3 & 4. basidiospores under SEM. — Scale bars: Fig. 1 = 2.5 mm; Fig. 2 = 5 mm; Figs. 3 & 4 = 2 μ m.

which is incompletely developed. Spore-sac 7–9 \times 4–6.5 mm diam., deformed by compression (Figs. 1 & 2). Mouth shortly tubular (Fig. 1), well developed in three spore-sacs and more or less immature in the remaining two. Exoperidium membranous, formed by a thin layer encrusted with soil, persisting at the base and other areas of the spore-sac (Fig. 1). Endoperidium smooth when exposed, cream-coloured. Gleba ferruginous. Stem fragmented in most cases (the only complete one is not well developed), the larger pieces 26 \times 2 mm, cylindric, greyish brown, striate, widened to 4 mm diam. at the base.

Basidiospores 8–12.5 μ m diam., mostly 9–9.5 μ m, globose, yellowish-ochre, distinctly spiny under LM, spines up to 1 μ m long; under SEM the ornamentation is verrucose to spiny, but always dense (Figs. 3 & 4). Capillitium made up of filaments of a diameter generally narrower than the spores, 2–8 μ m diam., thick-walled, frequently septate, branched, subhyaline, broadened at the pale ochraceous septa, up to 11 μ m diam. Exoperidium formed

by interwoven, relatively thick-walled, scantily branched, pale yellow threads, 2–4 μm diam., hardly broader at the infrequent and uncoloured septa. Endoperidium formed by filaments similar to those of the capillitium, 2–5 μm diam., densely interwoven, thick-walled, branched, pale yellow, broader at the uncoloured septa, up to 6.5 μm diam.

Collection studied. AUSTRALIA: New South Wales, Dubbo, leg. *J.B. Cleland*, 16-VII-1915, AD 17278, holotype.

2. *Tulostoma meridionale* J.E. Wright — Figs. 5–9

Tulostoma meridionale J.E. Wright in Wright et al., *Ciencia (Mexico)* 27 (1972) 117.

This collection consists of eight basidiocarps, five of them practically complete and three with fragmented stems (Fig. 5). Spore-sac 7–14 mm diam., subglobose (Figs. 5–7). Mouth circular, slightly projecting (Figs. 6 & 7). Exoperidium persistent, very thinly membranous with particles of soil externally adhering (Fig. 7). Endoperidium smooth, cream-coloured. Gleba ferruginous. Stem 7–22 \times 1–2 mm, greyish brown, widened to 4 mm diam. at the base (Fig. 5).

Basidiospores 6.5–8 μm diam., but 5.4–8(–12.6) or 7.6–9 \times 6.7–8 μm diam. in the original description (Wright et al., 1972), globose-subglobose, pale ochraceous, with a clearly verrucose ornamentation under LM; the ornamentation under SEM consists of big and well developed verrucae, which sometimes form groups fused at the apices (pyramidal aspect) (Figs. 8 & 9). Capillitium 2–6 μm diam., thick-walled, frequently septate, branched, subhyaline, broader at the slightly ochraceous septa, up to 9 μm diam. The microscopic features of the exoperidium were obscured by the presence of soil.

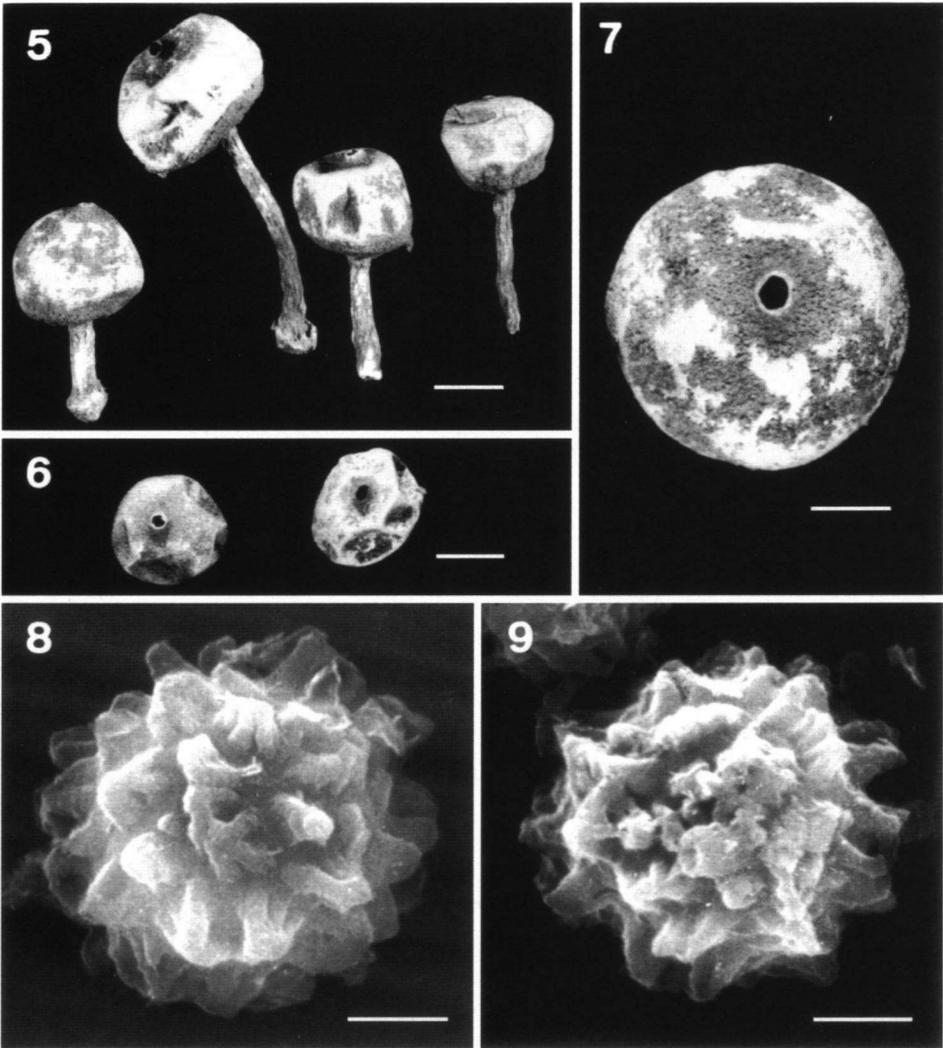
Collection studied. USA: Texas, Denton, leg. *W.H. Long*, XII-1907, Herb. Lloyd 53153 (BPI), holotype.

3. *Tulostoma utahense* J.E. Wright — Figs. 10–14

Tulostoma utahense J.E. Wright, *The genus Tulostoma (Gasteromycetes), A world monograph* (1987) 204.

The type material consists of seven basidiocarps with their stems quite fragmented (Fig. 10). Spore-sac 8–12 mm diam., deformed by compression (Figs. 10–12). Mouth circular, slightly projecting (Figs. 10–12). Exoperidium thinly membranous internally (where in contact with the endoperidium), but outwardly its aspect is rather hyphal and mixed with sand grains. Endoperidium smooth, cream-coloured. Gleba ferruginous. Stem fragmented, up to 2.5 mm diam., greyish brown, but whitish where decorticated, increasing to 7 mm diam. at the base.

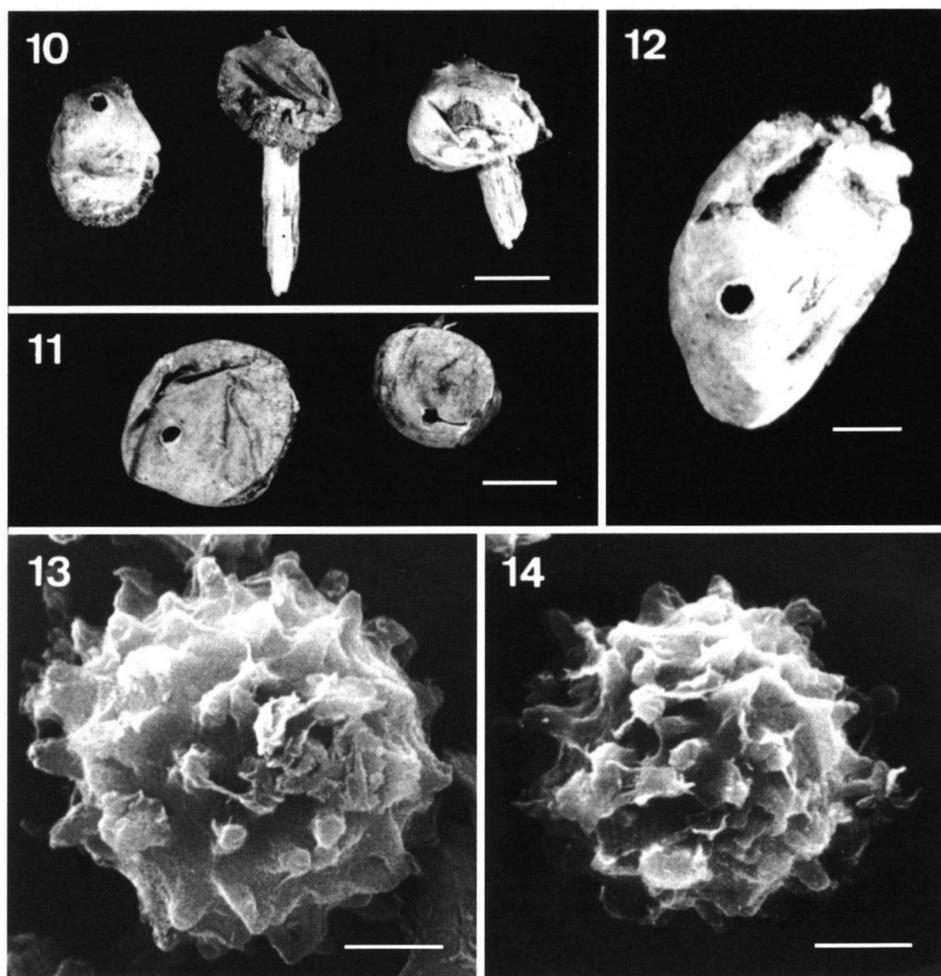
Basidiospores 7–9 μm diam., averaging 8 μm , globose-subglobose, pale ochraceous, with notable verrucose ornamentation under LM. The basidiospores usually appear collapsed under SEM, not very well developed, or covered with abundant remains from the disintegration of the mature gleba; these are the reasons why it is difficult to demonstrate clearly the type of ornamentation that characterize this species. However, the spore ornamentation seems to consist of large verrucae (Figs. 13 & 14) which sometimes form groups fused at the apices, like those in *T. meridionale*. Capillitium 2–7 μm diam., thick-walled, branched, subhyaline, usually broadened at the slightly ochraceous septa, up to 10 μm diam. Exoperidium formed by collapsed or degenerated hyphae.



Figs. 5–9. *Tulostoma meridionale*, holotype (Herb. Lloyd 53153, BPI). 5 & 6. Basidiocarps and spore sacs; 7. detail of a spore-sac with its slightly tubular mouth and persistent remains of the exoperidium 8 & 9. basidiospores under SEM. — Scale bars: Figs. 5 & 6 = 6 mm; Fig. 7 = 3 mm; Figs. 8 & 9 = 2 μ m

Collection studied. USA: Utah, Salt Lake City, beaches above City Creek, leg. A.O. Garret 2585, 21-III-1920, NY, holotype.

In our opinion, *T. meridionale* and *T. utahense* must be considered synonymous on account of the absence of significant differences between their type collections. *Tulostoma meridionale* has been reported only from North America, definitely from the USA and Mexico (Wright, 1987; Moreno et al., 1995).



Figs. 10–14. *Tulostoma utahense*, holotype (NY). 10 & 11. Basidiocarps and spore-sacs; 12. detail of a spore-sac with its slightly tubular mouth; 13 & 14. basidiospores under SEM. — Scale bars: Figs. 10 & 11 = 5 mm; Fig. 12 = 2 mm; Figs. 13 & 14 = 2 μ m.

Tulostoma meridionale J.E. Wright in Wright et al., *Ciencia (Mexico)* 27 (1972) 117 = *T. utahense* J.E. Wright, *The genus Tulostoma (Gasteromycetes), A world monograph* (1987) 204.

Though *T. macrosporum* is macroscopically very similar to *T. meridionale*, it must be maintained as an autonomous species on account of the differences in size and ornamentation of its spores. *Tulostoma macrosporum* has been recorded, other than in Australia, in South Africa, California (doubtfully) (Wright, 1987), and Mexico (Guzmán et al., 1992), fruiting in xeric zones.

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