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**Two Little-Known Species of *Mortierella***

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**Abstract.** – Isolates of *Mortierella* are described which may fit the two old and little-known species, *M. simplex* van TIEGHEM & LE MONNIER (sect. *Simplex*) and *Mortierella biramosa* van TIEGHEM (sect. *Mortierella*).

**Introduction**

Several old taxa were included in LINNEMANN'S (1970) monograph of *Mortierella* without any observations additional to the first descriptions. Most of these are still insufficiently known and unavailable as living cultures. They were therefore excluded from a key published by GAMS (1977), although their recognition may be perfectly justified. Two such taxa are the subject of this paper.

*M. simplex* VAN TIEGHEM & LE MONNIER has previously been available in vitro only in a few, more or less atypical cultures, but its discovery on natural substrates has allowed some crucial observations. The second species, *Mortierella biramosa* VAN TIEGHEM, was thought to represent an abnormally developed *M. gamsii* MILKO (= *M. spinosa* LINNEM.) or *M. polycephala* COEMANS until two recent isolates obtained from conifer rootlets confirmed the justification of recognizing this species.

1. *Mortierella simplex* VAN TIEGHEM & LE MONNIER, Ann. Sci. nat. Bot., Sér. 5, 17: 350. 1873. – Figs. 1–4. (Sect. *Simplex* W. GAMS, 1969).

Sporangiophores forming a dense mat on the natural substrate (Fig. 1). Sporangioophores unbranched, 650–700 µm tall, gradually tapering from 40–60 µm to 25–35 µm wide. – Sporangia many-spored, 125–150 µm diam, leaving a conspicuous collar after dehiscence. – Spores subglobose to slightly angular, smooth-walled, 13–15 µm diam. (Fig. 2).

In vitro (Fig. 3), sporulation is best on 2% (4%) MEA at 10–15°C, colonies reaching 9 cm diam in 7 days at 15–20°C. Garlic-like odour absent. – Aerial mycelium cottony, slightly zonate, forming numerous irregular bead-like hyphal swellings, 7–15 µm diam. Commonly producing one-spored sporangia on rather short and thin sporangiophores, 100–120 µm long, 3–5 µm

wide at the base, with spores conspicuously warted, 12–23 (–28)  $\mu\text{m}$  diam. – Sporangioophores with many-spored sporangia, (50–100  $\mu\text{m}$  diam) seldom produced, sometimes arising from a few basal rhizoids, usually narrower than on the natural substrate, 600–950  $\mu\text{m}$  long and 25–50  $\mu\text{m}$  wide near the base. Many-spored



Fig. 1: Mat of sporangioophores of *Mortierella simplex* on the natural substrate.  
ca.  $\times 75$ .

sporangia forming a continuous series with one-spored sporangia via few-spored sporangia, which contain weakly ornamented spores, 10–20  $\mu\text{m}$  diam. – Zygosporoes unknown. – Description based on CBS 243.82.

Material examined. – CBS 110.68, isolated from oat-field soil, Wageningen, Netherlands, by J. W. VEENBAAS-RIJKS (now almost sterile). – CBS 751.68, isolated from agricultural soil, Wageningen, Netherlands, by J. W. VEENBAAS-RIJKS (producing almost exclusively one-spored sporangia). – CBS 243.82, isolated from compost heap, Baarn, Netherlands, by W. GAMS, 17 Feb. 1982.

All these isolates showed some growth at 0° C after 7 days, good growth at 3–10° C (reaching 32 mm diam in 6 days on 2% MEA and other media), optimal growth between 15 and 20° C,

filling a 9 cm petri dish in 7 days; no growth occurred at 24° C and above. Even at -2° C some growth was observed on 4% MEA and cherry decoction agar in CBS 243.82. This species can therefore be considered as psychrophilic.

Discussion. — GAMS (1963) described a comparable polymorphism of sporangia ranging from many-spored to single-spored

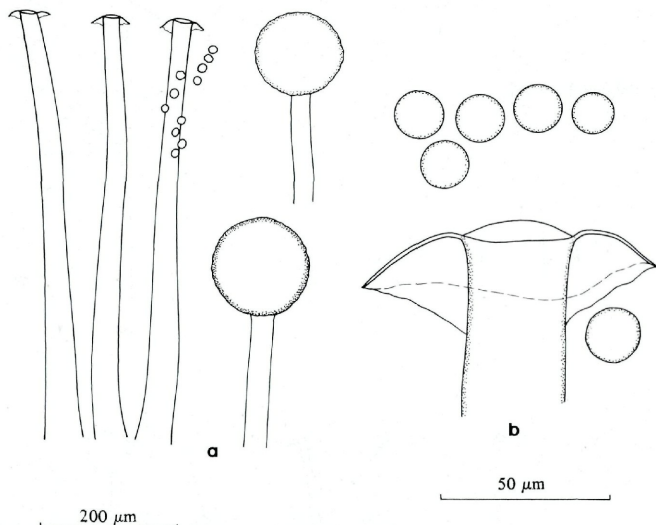


Fig. 2: *Mortierella simplex* (CBS 243.82 in vivo). — a. Sporangiophores, some with intact sporangia. — b. sporangiophore tip with sporangial wall and spores.

for the similar *Mortierella angusta*, but this finding was disputed by LINNEMANN (1970). Unfortunately it is hardly possible to maintain and reproduce the plasticity of this group of *Mortierella* species in culture over many years. Lyophilization of these species was not successful. All available older cultures are now more or less degenerated and rarely develop many-spored sporangia.

The combination *M. angusta* (LINNEMANN) W. GAMS was not validly published by GAMS (1963, Art. 33). LINNEMANN (1970) then published *M. angusta* as "LINN. n. sp.", which again would be invalid for a new species, but was recognized as sufficient for creating the new combination *M. angusta* (LINNEM.) LINNEM. (Index of Fungi 4: 597. 1980). LINNEMANN (1970) distinguished *M. angusta* from *M. sim-*

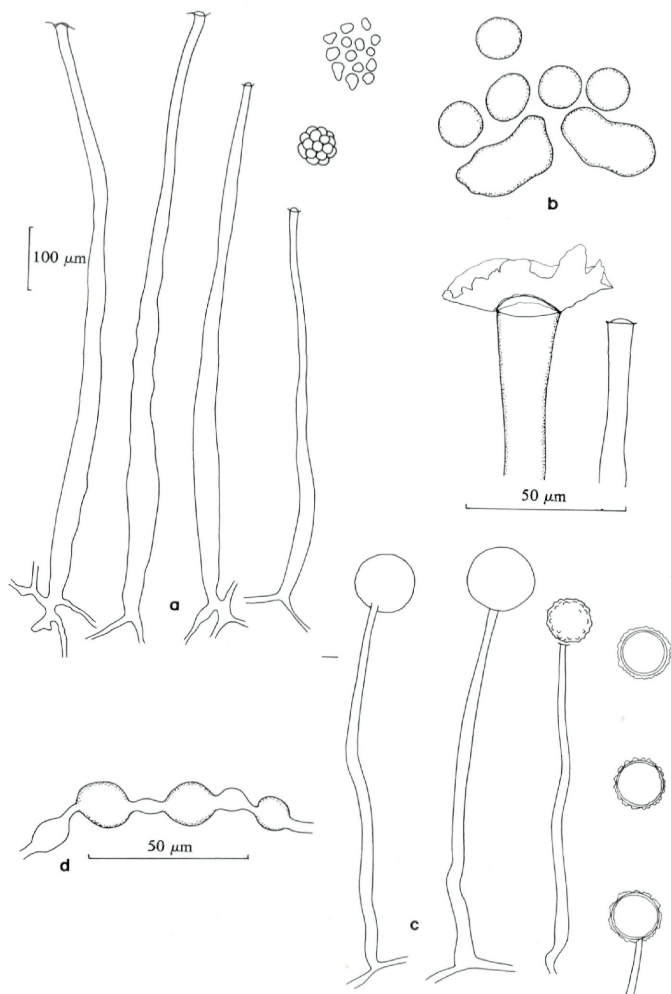


Fig. 3: *Mortierella simplex* (CBS 243.82 in vitro). – a. Sporangiophores bearing many-spored sporangia. – b. sporangiophore tips and spores. – c. sporangiophores bearing one-spored sporangia. – d. hyphal swellings.

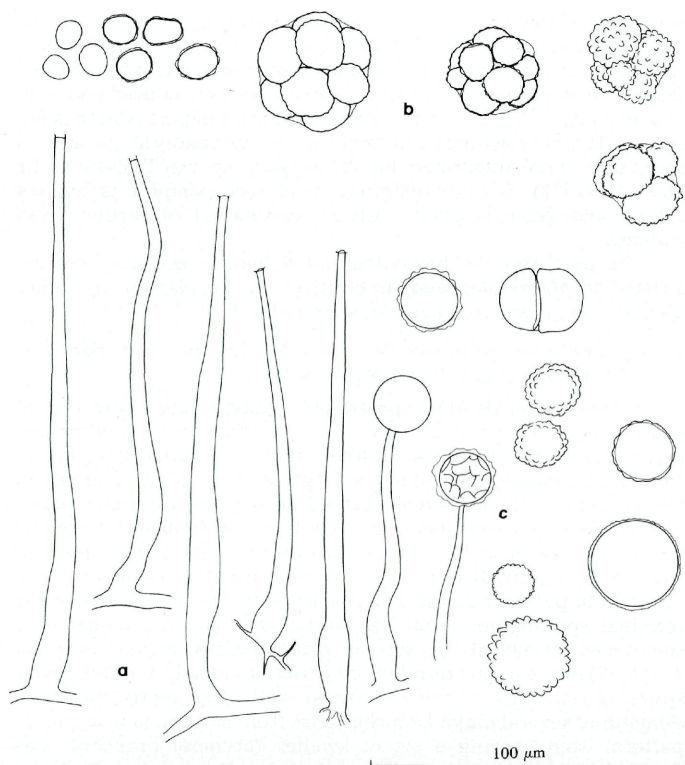


Fig. 4: *Mortierella simplex* (CBS 110.68 and 751.68). – a. Sporangiophores. – b. many- and few-spored sporangia and spores. – c. one-spored sporangia. Drawn from pure culture on potato-carrot agar in 1968.

*plex* by the lack of basal rhizoids and the broadly warted “stylospores”. GAMS (1977) distinguished *M. angusta* (CBS 293.61) from *M. simplex* by slightly shorter (to 600 µm) and narrower (to 30 µm wide) sporangiophores and the common occurrence of hyphal swellings. But this distinction cannot be considered reliable in view of the variation observed here. Unfortunately, no fresh isolates of *M. angusta* were obtained from recent samples of Delamere Forest soil (Cheshire), where the species had been isolated previously, to allow a comparison. *M. simplex* was originally described from moist



soil. The isolates obtained from Wageningen (Fig. 4) originally had slightly smaller spores, 7–9  $\mu\text{m}$  diam, formed in many-spored sporangia, and had a garlic-like smell (not mentioned in the original diagnosis); hyphal swellings were less commonly produced and were mostly solitary. Their conspecificity with the compost isolate is not certain. Hyphal swellings and “stylospores” (probably single-spored sporangia) were illustrated for *M. simplex* by VAN TIEGHEM & LE MONNIER (1873). Species delimitation in sect. *Simplex* is not yet settled and depends upon critical examination of further fresh isolates.

The psychrophilic behaviour noted here is certainly not restricted to *M. simplex* and its relatives. *M. parvispora* and other species also grew at temperatures around 0° C.

2. *Mortierella biramosa* VAN TIEGHEM, Ann. Sci. nat., Bot. Sér. 6, 1: 110. 1875. – Fig. 5. (Sect. *Mortierella*).

Colonies on 2% MEA spreading broadly, filling a petri dish of 9 cm diam in 5 days at 20° C, with a homogeneous loosely cottony aerial mycelium, with garlic-like smell. – Sporangioophores formed abundantly on soil extract agar and 2% MEA, variable in size and shape, the large ones (1250–1500  $\mu\text{m}$ ) arising from clusters of rhizoids, slightly smaller ones (300–1200  $\mu\text{m}$ ) from aerial hyphae; width near the base 20–30  $\mu\text{m}$ ; 3–7 branches arising in a racemose pattern at slightly different levels (rarely from the same level in a verticillate pattern) in the apical part until 75–150  $\mu\text{m}$  below the terminal sporangium, branches 50–150  $\mu\text{m}$  long, the longer ones sometimes branched in second order, width rather constant 4–10(–15)  $\mu\text{m}$ , without terminal constriction, mostly retaining conspicuous remnants of the sporangial wall after spore liberation. Sometimes several major branches arise from one hypha in a cymose pattern, each bearing a set of smaller racemose branches; this double branching is expressed in the name. – Sporangia 30–40  $\mu\text{m}$  diam. – Spores globose, smooth-walled, 5–6(–8)  $\mu\text{m}$  diam, with granular contents. – Chlamydospores and stylospores absent. – No zygospores were obtained after mating the two isolates.

Material examined. – CBS 550.80 and CBS 506.81, both isolated from decaying rootlets of 30-year-old *Pseudotsuga menziesii* on acidic loamy soil (Upper Buntsandstein), Odenwald, F. R. Germany, by S. SCHÖNHAR, Stegen-Wittental, 1980 and 1981, respectively.

Discussion. – This fungus is the only one available that reasonably fits VAN TIEGHEM's (1875) diagnosis of *M. biramosa*, which was originally isolated from rat excrements. The isolates from conifer roots only differ from the original description and illustration by racemose rather than verticillate arrangement of the sporan-

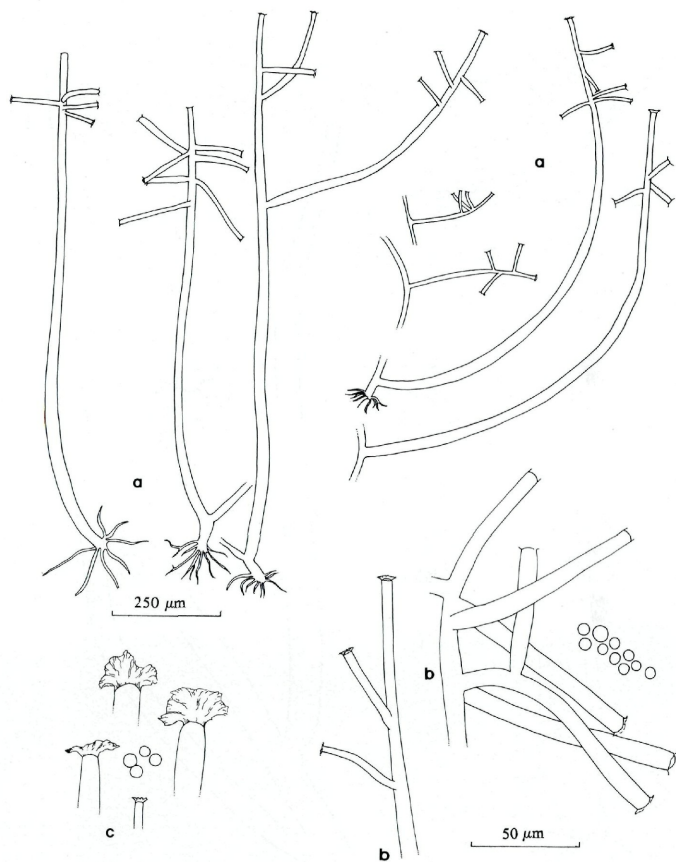


Fig. 5: *Mortierella biramosa*. – a. Variation of sporangiophore branching. – b. details of branching. – c. sporangiophore tips with remnants of sporangial wall and spores from culture partly on MEA, partly on soil extract agar (CBS 550.80).

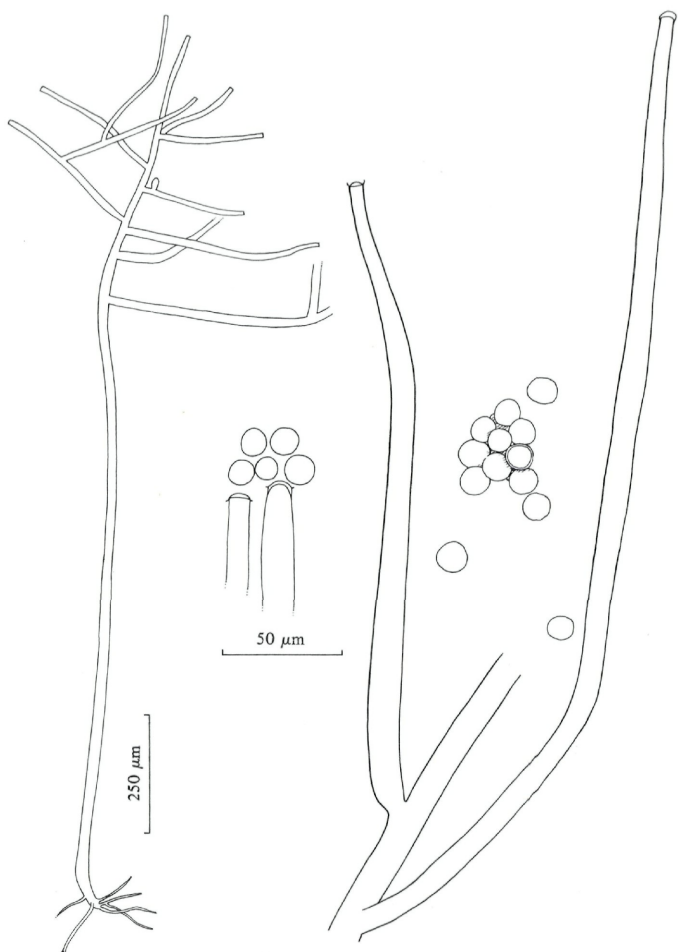


Fig. 6: *Mortierella nantahalensis*. – Sporangiophore with detail of branches and spores from culture on soil extract agar (CBS 618.70).



giophore branches and absence of "stylospores". No other described *Mortierella* species is appropriate for these isolates. Stylospores were also described for the well-known *M. reticulata* by VAN TIEGHEM & LE MONNIER (1873), an observation that could not be verified. *M. reticulata* forms only smooth-walled chlamydospores in the submerged mycelium. Thus no great value can be attributed to such a statement in the original diagnosis. The branching pattern of *M. biramosa* is a mixture of racemose (the terminal branchlets) and cymose (renewed growth of sporangiophores). VAN TIEGHEM (1875) regarded *M. biramosa* as intermediate between *M. candelabrum* VAN TIEGH. & LE MONNIER (a species possibly identical with *M. gamsii* MILKO) and *M. polycephala* COEMANS. Regular verticillate branching is known only in *M. umbellata* CHIEN, which, however, has kidney-shaped spores,  $12-14 \times 5-7 \mu\text{m}$ . Based upon the apical racemose branching, the classification of *M. biramosa* in sect. *Mortierella* seems most appropriate. This conclusion is also supported by the sturdy sporangiophores commonly arising from basal rhizoids, as well as the flaring remnants of the sporangial wall, lacking any trace of a columella. *M. biramosa* as described here is very close to *M. nantahalensis* CHIEN (1971) (Fig. 4), which should also be classified in sect. *Mortierella* and not in sect. *Spinosa* LINNEM. as suggested by GAMS (1977). Its sporangiophores and branches are taller than in *M. biramosa* and the spores are larger,  $10-14 \mu\text{m}$  diam.

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