PERSOONIA
Published by the Rijksherbarium, Leiden
Volume 9, Part 3, pp. 381–391 (1977)

# A KEY TO THE SPECIES OF MORTIERELLA

W. GAMS

*Centraalbureau voor Schimmelcultures, Baarn*

A key is provided covering only those species of *Mortierella* of which living cultures are available and which are recognized as specifically distinct. Two subgenera, *Micromucor* subgen. nov. and *Mortierella*, and nine sections in the latter are distinguished. The recognized species are listed with some new synonymies and bibliographic documentation. Three species which were invalidly published by Linnemann in 1936 are validated.

After Linnemann's (*in* Zycha & Siepmann, *1970*) and Mil'ko's (*1974*) fairly complete compilations of the species so far described in *Mortierella*, it now seems inappropriate and premature to provide another revision of the genus. This key is mainly written for practical purposes, arising from the need to provide a concise survey of the recognized species. It covers the species of which living cultures are available and which are considered sufficiently distinct to deserve a specific status. A considerable number of species has not been found again since their original description and their status is somewhat doubtful; others are considered to be synonyms of recognised species from their diagnosis and yet others have been synonymized on the basis of available type cultures and, further, some species are not recognized because they have not been validly published. All these taxa have been omitted from this key.

The species grouped around *Mortierella ramanniana* (Möller) Linnem. and *M. isabellina* Oudem. with velvety growth and mostly pigmented sporangia form a distinct group without affinity to other species of the genus. They deserve distinction at a higher than sectional rank but are retained in *Mortierella* for the time being as long as it cannot be decided objectively whether they belong to the Mortierellaceae A. Fischer or rather the Mucoraceae Dumort.

## **Mortierella** subgen. **Micromucor** W. Gams, *subgen. nov.*

*Mucor* sect. *Ramannianus* Zycha *in* Krypt.-Fl. Brandenb. **6a**: 57. 1935 (nom. inval.; Intern. Code Bot. Nomencl., ed. 1972, Art. 36).

*Mucor* sect., *Micromucor* Naumov, Opredel. Mukorovykh (Mucorales) (Izd. 2): 27. 1935 (nom. inval., Art. 36).

*Mortierella isabellina* group Turner *in* Trans. Br. mycol. Soc. **46**: 262. 1963 — *Mortierella* sect. *Isabellina* Linnem. *in* Zycha & Siepm., Mucorales: 156. 1970 ('1969') (nom. inval., Art. 36).

MISAPPLIED: *Mortierella* sect. *Pusilla* Linnem., Mucorineen-Gatt. *Mortierella*: 16. 1941 (*M. pusilla* Oudem., a species of doubtful identity, obviously does not belong to this group).

Coloniae velutinae nec arachnoideae, non distincte olentes. Sporangiophora erecta, plus minusve ramosa; sporangia plerumque rubra vel ochracea, pluri- vel unispora, columella parva praesente vel absente. Species typica *Mortierella ramanniana* (Möller) Linnem.

Species of this subgenus show their characters most clearly on 2% malt extract agar. The monographic treatment of this group by Turner (*1963*) provides a sound base for species delimitation, and her arrangement is followed with some additions.

The other subgenus, *Mortierella*, is characterized by white, arachnoid colonies often with lobed or rosette patterns and mostly with a garlic-like odour. The morphological features of this group are described from cultures growing on soil extract agar or potato-carrot agar, as outlined by Gams (*1970*), and the arrangement in nine sections, proposed in that paper, has been retained.

While a considerable number of species remains doubtful and might eventually be elucidated when isolates become available which cannot be identified with this key, some old species have already been rediscovered recently and a number of new species has been added (Gams, *1976*). The locations of the diagnoses and the first discoveries of zygospores of the recognized species, as well as some synonymies, are given at the end of this study.

## KEY TO THE SUBGENERA, SECTIONS AND SOME ISOLATED SPECIES

1a. Colonies velvety, not exceeding 3 mm in height; sporangia mostly ochraceous or vinaceous, often with a small columella; without distinctive odour . subgen. *Micromucor* (I)
b. Aerial mycelium consisting of longer, ascendent or prostrate hyphae, white, cottony or arachnoid; sporangia usually not pigmented, without or with a rudimentary columella; mostly with a garlic-like odour . . . . . subgen. *Mortierella* (II) 2
2a. Only chlamydospores present (recognizable as *Mortierella* by colony habit and odour) 3
b. Sporangiophores and sporangia (sporangioles) present . . . . . 6
3a. Chlamydospores smooth-walled: no further species identification possible
b. Chlamydospores ornamented, not exceeding 30 µm diam. (if bigger, cf. *M. alliacea*) 4
4a. Chlamydospores covered with relatively few blunt spines up to 4 × 1 µm, terminal or intercalary, mostly 15–26 µm diam.; homothallic. . . . . *M. chlamydospora*
b. Chlamydospores more densely fimbriate . . . . . 5
5a. Chlamydospores mostly terminal, sometimes intercalary, densely covered with straight 1–2 µm long spines, mostly 14–21 µm diam.; heterothallic . . . . . *M. indohii*
b. Chlamydospores mostly intercalary, sometimes terminal, with sometimes flexuous blunt spines up to 5 × 1 µm, mostly 17–28 µm diam.; zygospores unknown . . *M. echinosphaera*
6a. Sporangiophores always unbranched . . . . . 7
b. Sporangiophores branched (at least sometimes) . . . . . 9
7a. Sporangiophores usually exceeding 200 µm in length . . . . . Sect. *Simplex* (1)
b. Sporangiophores less than 150 µm in length . . . . . 8
8a. Sporangia, at least partly, many-spored; sporangiophores with distinctly widening base (cf. also *M. horticola* in sect. *Stylospora*) . . . . . Sect. *Alpina* (2)
b. Sporangia one-spored; very slender sporangiophores arising in dense rows from the aerial hyphae . . . . . Sect. *Schmuckeri* (3)
9a. Sporangiophores racemosely branched with a thick main stem and thin, short branches 10
b. Branching in another way . . . . . 11
10a. Branches arising above the middle of the sporangiophore . . . . Sect. *Mortierella* (4) (if sporangiophores shorter than 100 µm with strongly swollen base, cf. Sect. *Haplosporangium*)

10b. Branches arising from the uppermost part of the sporangiophore in clusters from an inflated region . . . . . Sect. *Actinomortierella* (5)
11a. Branches arising mainly from the lower part of the sporangiophore (basitonous) . 12
b. Branches arising from the middle or upper part of the sporangiophore (mesotonous or acrotonous) . . . . . 13
12a. Sporangia containing many, or at least several, smooth or ornamented spores Sect. *Hygrophila* (6)
b. Sporangia one-spored, often ornamented . . . . . Sect. *Stylospora* (7)
13a. Sporangia many-spored; sporangiophores often bent upwards above an ascendent basal part and with a minute columella . . . . . Sect. *Spinosa* (8)
b. Sporangia one- or two-spored; sporangiophores short, with broad base, strongly tapered in the middle part and arising in dense rows from the aerial hyphae Sect. *Haplosporangium* (9)

## I. Subgenus MICROMUCOR

1a. Sporangia one-spored . . . . . 2
b. Sporangia many-spored . . . . . 3
2a. Sporangia hyaline; colonies white . . . . . *M. nana*
b. Sporangia reddish . . . . . *M. roseo-nana*
3a. Colonies shades of ochraceous-grey; spores slightly angular, 2–3 µm diam.; small chlamydospores scarcely produced . . . . . *M. isabellina*
b. Colonies pink, russet or lilac . . . . . 4
4a. Chlamydospores filled with lipid droplets, abundantly produced; sporangiophores always with a small distinct columella . . . . . 6
b. Chlamydospores small and scarce or absent . . . . . 5
5a. Sporangiophores slightly widened below the sporangium, sporangial wall mostly remaining as a large collarette; small columella often present; spores angular, 2–3 µm diam. . . . . *M. longicollis*
b. Sporangiophores not widened below the sporangium, without a collarette; columella hardly developed; spores angular, 3–4 µm diam. . . . . *M. vinacea*
6a. Spores angular; colonies somewhat brownish red . . . . *M. ramanniana* var. *angulispora*
b. Spores rounded; colonies in other red to vinaceous shades . . . . . 7
7a. Spores ellipsoidal; fungus requiring thiamin . . . . . *M. ramanniana* var. *ramanniana*
b. Spores globose; fungus not requiring thiamin . . . . . *M. ramanniana* var. *autotrophica*

## II. Subgenus MORTIERELLA

### 1. Section SIMPLEX W. Gams

*in* Nova Hedwigia **18**: 37. 1970 ('1969')

1a. Sporangia equal; all many-spored . . . . . 2
b. Sporangia unequal; partly many-spored, partly few- or one-spored . . . . . 9
2a. Clusters of vesicles present near the base of the sporangiophores . . . . . 3
b. Clusters of vesicles absent . . . . . 5
3a. Spores globose, finely warted, 5–7 µm diam. . . . . *M. globulifera*
b. Spores ellipsoidal to cylindrical, smooth-walled . . . . . 4
4a. Spores 11–16 × 6–8 µm . . . . . *M. tuberosa*
b. Spores 7–9 × 4–5 µm . . . . . *M. pilulifera*
5a. Amoeba-like chlamydospores with irregular appendages present . . . *M. amoeboidea*
b. Amoeba-like chlamydospores absent . . . . . 6

6a. Sporangiophores markedly constricted below the sporangium; spores 9–11 × 6–7 µm *M. strangulata*
b. Sporangiophores hardly constricted below the sporangium . . . . . 7
7a. Columella conspicuous; spores globose, 2–3 µm diam.. cf. *M. turficola* (Sect. *Hygrophila*)
b. Columella absent; spores much larger . . . . . 8
8a. Spores 5–6.5 × 3.5–4 µm, smooth-walled . . . . . *M. rostafinskii*
b. Spores 10–20 µm diam., with strongly undulate outer membrane and angular outline *M. ornata*
9a. Sporangiophores to 1000 µm long and 70 µm wide; spores subglobose, almost smooth-walled, about 10 µm diam., formed in many-spored sporangia; in addition verrucose spores, 12–25 µm diam., are formed in few-spored sporangia; chlamydospores absent *M. simplex*
b. Sporangiophores to 600 µm long and 30 µm wide; spores subglobose, either 8–11 µm diam., almost smooth-walled and formed in many-spored sporangia, or 12–24 µm and coarsely verrucose and formed in one- or few-spored sporangia; chlamydospore-like hyphal swellings present . . . . . *M. angusta*

## 2. Section ALPINA Linnem.

Mucorineen-Gatt. *Mortierella*: 35. 1941

1a. Sporangia always one-spored, globose, finely echinulate cf. *M. horticola* (sect. *Stylospora*)
b. Sporangia, at least partly, many-spored . . . . . 2
2a. Spores of many-spored sporangia elongate . . . . . 3
b. Spores of many-spored sporangia of other shapes . . . . . 4
3a. Fimbriate chlamydospores, 20–60(–120) µm diam., present . . . . . *M. alliacea*
b. Only small, indistinct, smooth-walled chlamydospores occasionally present . *M. alpina*
4a. Spores irregularly lobulate . . . . . *M. polygonia*
b. Spores more or less globose . . . . . 5
5a. Spores 3–10 µm diam; globose chlamydospores, 6–15 µm diam., fairly numerous *M. antarctica*
b. Spores 3–5 µm diam.; chlamydospores absent or scanty and little differentiated, elongate *M. globalpina*

## 3. Section SCHMUCKERI W. Gams

*in* Nova Hedwigia **18**: 38. 1970 ('1969')

1a. Sporangia globose . . . . . 2
b. Sporangia flattened, 10–15 µm diam.; sporangiophores mostly 20–50 µm long *M. schmuckeri*
2a. Sporangiophores 7–17 µm long; spores 5–6 µm diam. . . . . *M. claussenii*
b. Sporangiophores 25–45 µm long; spores 7–12 µm diam. . . . . *M. camargensis*

## 4. Section MORTIERELLA

Syn.: Section *Polycephala* Linnem., Mucorineen-Gatt. *Mortierella*: 24. 1941
emend. W. Gams *in* Nova Hedwigia **18**: 38. 1970 ('1969')

1a. Spores with reticulate walls . . . . . *M. reticulata*
b. Spores with smooth or granulate walls . . . . . 2
2a. Sporangia up to 5-spored; spores finely warty, 11–16 µm diam.; irregularly lobate chlamydospores present in the agar . . . . . *M. oligospora*

2b. Sporangia many-spored; aerial chlamydospores regularly spinulose . . . . . 3
3a. Spores smooth-walled, 10–12 µm diam. . . . . *M. polycephala*
b. Spores finely echinulate, 12–15 µm diam. . . . . *M. echinulata*

## 5. Section ACTINOMORTIERELLA (Chalabuda) W. Gams

*in* Nova Hedwigia **18**: 38. 1970 ('1969')

*Actinomortierella* Chalabuda *in* Nov. Sist. niz. Rast. 1968: 129

1a. Sporangiophores with an apical inflation from which short branches arise; chlamydospores absent . . . . . 2
b. Sporangiophores without an apical inflation but with numerous short branches arising close together in the uppermost part of the sporangiophore; chlamydospores present, covered with irregular appendages . . . . . cf. *M. wolfii* (sect. *Spinosa*)
2a. Apical inflation forming an apophysis bearing a terminal large sporangium and giving rise to several narrow branches with smaller sporangia; spores ellipsoidal, 4–9 × 3–6 µm *M. ambigua*
b. Inflation some distance below the terminal sporangium giving rise to numerous narrow branches; spores globose, 8.5–10 µm diam. . . . . *M. capitata*

## 6. Section HYGROPHILA Linnem.

Mucorineen-Gatt. *Mortierella*: 45. 1941

emend. W. Gams *in* Nova Hedwigia **18**: 39. 1970 ('1969')

1a. Sporangiophores not exceeding 120 µm in length; spores more or less globose . . . 2
b. Sporangiophores longer or spores ellipsoidal-cylindrical . . . . . 5
2a. Sporangiophores with branches arising almost from the same point very close to the base; sporangia few-spored; spores 4.5–12 µm diam., finely verrucose cf. *M. verticillata* (sect. *Stylospora*)
(If spores larger than 12 µm diam., cf. *M. hyalina*)
b. Sporangiophores with branches arising at different levels; sporangia many-spored. . 3
3a. Spores 4–7(–10) µm diam.; chlamydospores absent . . . . . *M. minutissima*
b. Spores not exceeding 4 µm diam.; chlamydospores present. . . . . 4
4a. Chlamydospores globose, 20–100(–300) µm diam.; spores 2–3 µm diam. *M. macrocystis*
b. Chlamydospores consisting of widened hyphal branches of irregular shape; spores 2.5–4.0 µm diam. . . . . *M. clonocystis*
5a. Chlamydospores aggregated in rows or clusters. . . . . 6
b. Chlamydospores, if present, not aggregated . . . . . 8
6a. Sporangiophores with an inflation below the sporangium; spores more or less globose, 8–12 µm diam. . . . . *M. beljakovae*
b. Sporangiophores not inflated apically; spores ellipsoidal to cylindrical . . . . . 7
7a. Spores with a single membrane, 8–11 × 4–6 µm . . . . . *M. zychae*
b. Spores with a double membrane, 3.5–8 × 2.0–3.3 µm . . . . . *M. parazychae*
8a. Chlamydospores usually exceeding 20 µm diam. . . . . 9
b. Chlamydospores smaller or absent . . . . . 12
9a. Spores globose, 6–10 µm diam., minutely striate; chlamydospores 50–100 µm diam., covered with short fimbriate hyphae . . . . . *M. sclerotiella*
b. Spores ellipsoidal or reniform, smooth-walled . . . . . 10
10a. Spores irregularly reniform, 18–26 × 8–12 µm; chlamydospores 40–60 µm diam. *M. armillariicola*
b. Spores ellipsoidal, smaller. . . . . 11

11a. Spores short-ellipsoidal, 14–16 × 9–11 µm; chlamydospores 35–50 µm diam., thick- and smooth-walled . . . . . *M. gemmifera*
b. Spores ellipsoidal-fusiform, 5.5–8.5 × 2.0–3.0 µm; chlamydospores to 40 µm diam., thin-walled, sometimes with papillate appendages . . . . . *M. elongatula*
12a. Spores globose to subglobose . . . . . 13
b. Spores distinctly elongate . . . . . 17
13a. Spores completely or almost smooth-walled . . . . . 14
b. Spores with distinctly ornamented wall . . . . . 16
14a. Spores 3–5 µm diam. . . . . *M. basiparvispora*
b. Spores much larger . . . . . 15
15a. Sporangiophores with apophysis-like inflation; spores smooth-walled, 8–12 µm diam.; chlamydospores often in groups . . . . . *M. beljakovae*
b. Sporangiophores without any inflation; spores minutely roughened, 8–25 µm diam.; chlamydospores formed solitarily . . . . . *M. hyalina*
16a. Sporangiophores 320– over 500 µm long; spores 8–10(–14) µm diam., echinulate *M. echinula*
b. Sporangiophores 60–160(–260) µm long; spores 6–12(–16) µm diam., verrucose *M. verrucosa*
17a. Spores crescent-shaped, 15–20 × 5–9 µm. . . . . *M. selenospora*
b. Spores cylindrical or ellipsoidal . . . . . 18
18a. Sporangiophores 2–3 mm long, 18–20 µm wide at the base; spores 5–10 × 3–5 µm; chlamydospores absent . . . . . *M. bainieri*
b. Sporangiophores shorter and/or more slender and/or spores smaller . . . . . 19
19a. Sporangiophores with 8–14 µm wide apophysis-like inflation; spores 8–12(–17) × 4–5 (–7) µm . . . . . *M. kuhlmanii*
b. Sporangiophores without any inflation . . . . . 20
20a. Homothallic species with numerous naked zygospores produced on malt extract agar; spores fusiform with rounded ends, 9–14 × 3–6 µm; chlamydospores absent *M. epigama*
b. Heterothallic species or zygospores unknown; spores ellipsoidal to cylindrical. . . 21
21a. Sporangiophores usually with a rather long (to 600 µm) and mostly 10–12 µm wide, unbranched basal portion; spores 3.5–4 × 2.0–2.5 µm . . . cf. *M. jenkinii* (sect. *Spinosa*)
b. Sporangiophores branched near the base and/or spores larger and/or more slender 22
22a. Sporangiophores 100–200(–400) µm long; spores 6–9 × 3.0–4.5 µm; chlamydospores absent . . . . . *M. sarnyensis*
b. Sporangiophores longer. . . . . 23
23a. Sporangiophores up to 1 mm and longer, at the base usually not exceeding 6 µm diam., branching in the middle; spores 4.5–8 × 3–5 µm . . . . . *M. dichotoma*
b. Sporangiophores mostly not exceeding 400 µm, 5–15 µm wide at the base and 1.5–3.5 µm at the tip, with typically basitonous ramification; spores 7–13(–16) × 3.5–7 µm *M. elongata*

### 7. Section STYLOSPORA Linnem.

Mucorineen-Gatt. *Mortierella*: 20. 1941

1a. Sporangiophores always unbranched; sporangia 7–12 µm diam., minutely spinulose *M. horticola*
b. Sporangiophores basitonously branched. . . . . 2
2a. Sporangia with reticulate walls . . . . . *M. stylospora*
b. Sporangia with spinulose or smooth walls . . . . . 3
3a. Sporangiophores 5–7 µm wide at the base, strongly tapering in the middle part to 1.0–1.8 µm at the tip; sporangia echinulate, 8–18 µm diam. . . . . *M. lignicola*
b. Sporangiophores tapering gradually to 1.5–3.0 µm at the tip . . . . . 4

4a. Sporangia smooth-walled, 10–25 μm diam. . . . . *M. zonata*
b. Sporangia finely ornamented, smaller. . . . . 5
5a. Sporangia finely spinulose, always one-spored, with the outermost layer firmly attached to the spore. . . . . *M. humilis*
b. Sporangia often few-spored; spores irregularly warty, with a loose outer layer *M. verticillata*

## 8. Section SPINOSA Linnem.

Mucorineen-Gatt. *Mortierella*: 52. 1941
emend. W. Gams *in* Nova Hedwigia **18**: 39. 1970 ('1969').

1a. Sporangiophores generally not exceeding 200 μm in length. . . . . 2
b. Sporangiophores typically much longer . . . . . 4
2a. Spores globose, 18–25 μm diam., with a double membrane . . . . . *M. acrotona*
b. Spores much smaller, with a single membrane . . . . . 3
3a. Chlamydospores constantly absent; spores 3–4 μm diam. . . . . *M. pulchella*
b. Chlamydospores scarcely produced, lemon-shaped, about 6 μm diam.; spores 4–7(–10) μm diam. . . . . *M. epicladia*
4a. Sporangiophores with umbellate branches arising from the same level; spores plano-convex, 12–14 × 5–7 μm . . . . . *M. umbellata*
b. Sporangiophores with branches inserted at different levels; spores of other shapes 5
5a. Spores globose to subglobose . . . . . 6
b. Spores ellipsoidal to cylindrical . . . . . 8
6a. Spores not exceeding 4 μm diam. . . . . *M. parvispora*
b. Spores larger . . . . . 7
7a. Sporangiophores often exceeding 1 cm in length; spores more than 10 μm diam. *M. nantahalensis*
b. Sporangiophores 200–800 μm long; spores less than 10 μm diam. . . . . *M. gamsii*
8a. Chlamydospores densely covered with blunt spines; spores 4.0–5.5 × 2.0–3.0 μm *M. fimbricystis*
b. Chlamydospores if present, smooth-walled or irregularly lobate. . . . . 9
9a. Spores not exceeding 5.5 μm in length; chlamydospores regularly globose, lemon-shaped, or absent . . . . . 10
b. Spores larger; chlamydospores bearing irregularly lobate appendages . . . . . 11
10a. Chlamydospores absent or tardily produced and lemon-shaped; sporangiophores 400 to more than 1500 μm tall; spores 3.5–4.0(–5.0) × 2.0–2.5 μm . . . . . *M. jenkinii*
b. Chlamydospores abundantly produced, globose, 20–60 μm diam., thick-walled; sporangiophores usually not exceeding 300 μm; spores 3–4 × 1.2–2.0 μm *M. cystojenkinii*
11a. Sporangia leaving a pronounced collarette; spores with a double membrane *M. wolfii*
b. Sporangia not leaving a collarette but with a trace of a columella; spores with a single membrane . . . . . *M. exigua*

## 9. Section HAPLOSPORANGIUM (Thaxt.) W. Gams

*in* Nova Hedwigia **18**: 40. 1970 ('1969')
*Haplosporangium* Thaxt. *in* Bot. Gazette **58**: 362. 1914.

Sporangia one- or two-spored . . . . . *M. bisporalis*

## THE RECOGNIZED SPECIES OF MORTIERELLA

Epithets in alphabetical order with references to the first descriptions, some important redescriptions and first descriptions of zygospores (Z.), followed by facultative synonyms (S.). Other information is to be found in Zycha & Siepmann (*1970*), Mil'ko (*1974*) and Linnemann (*1941*).

*acrotona* W. Gams *in* Persoonia **9**: 133. 1976.
*alliacea* Linnem., *in* Zentbl. Bakt. ParasitKde (II. Abt.) **107**: 225. 1953.
*alpina* Peyron., Germi atmosferici, Diss. Padova: 17. 1913. Z.: Kuhlman *in* Mycologia **67**: 674. 1975.
S.: *M. renispora* Dixon-Stewart *in* Trans. Br. mycol. Soc. **17**: 214. 1932. Z.: ibid.
*M. thaxteri* Björling *in* Bot. Notiser 1936: 116.
*M. monospora* Linnem. *in* Flora **130**: 210. 1936 (nom. inval., Art. 36).
*M. acuminata* Linnem., Mucorineen-Gatt. *Mortierella*: 21. 1941.
*ambigua* B. S. Mehrotra *in* Mycologia **55**: 291. 1963.
*amoeboidea* W. Gams *in* Persoonia **9**: 116. 1976.
*angusta* (Linnem.) W. Gams *in* Ber. naturw.-med. Ver. Innsbruck **53**: 73. 1963. — *M. polycephala* var. *angusta* Linnem., Mucorineen-Gatt. *Mortierella*: 29. 1941.
*antarctica* Linnem. apud Zycha & Siepmann, Mucorales: 198. 1970 ('1969') ex Linnem. *in* Nova Hedwigia **19**: 565. 1971 ('1970').
*armillariicola* W. Gams *in* Persoonia **9**: 128. 1976.
*bainieri* Cost. *in* Bull. Soc. mycol. Fr. **4**: 150. 1889; Z.: Kuhlman *in* Mycologia **64**: 325. 1972.
*basiparvispora* W. Gams & Grinbergs *in* Persoonia **9**: 130. 1976.
*beljakovae* Milko *in* Nov. Sist. niz. Rast. 1973: 83; Gams *in* Persoonia **9**: 124. 1976. Z.: Kuhlman *in* Mycologia **64**: 325. 1972 (as *M.* '*candelabrum*').
*bisporalis* (Thaxt.) Björling *in* Bot. Notiser 1936: 126. — *Haplosporangium bisporale* Thaxt. *in* Bot. Gaz. **58**: 363. 1914.
S.: *M. decipiens* (Thaxt.) Björling *in* Bot. Notiser 1936: 126. — *Haplosporangium decipiens* Thaxt. *in* Bot. Gaz. **58**: 364. 1914.
*camargensis* W. Gams & R. Moreau *in* Annls Univ. Besançon (Sér. 2) **3**: 103. 1960. — *Haplosporangium gracile* Nicot *in* Bull. trimest. Soc. mycol. Fr. **73**: 87. 1957.
*capitata* March. *in* Bull. Soc. r. Bot. Belg. **29**: 134. 1891. Embree *in* Trans. Br. mycol. Soc. **46**: 560. 1963.
S.: *M. vesiculosa* B. S. Mehrotra *& al. in* Mycologia **55**: 295. 1963.
*chlamydospora* (Chesters) Plaats-Niterink *in* Persoonia **9**: 91. 1976. — *Azygozygum chlamydosporum* Chesters *in* Trans. Br. mycol. Soc. **18**: 213. 1933. Z.: Chesters, l. c.; van der Plaats-Niterink *& al.*, l. c.
*claussenii* Linnem. *in* Arch. Mikrobiol. **30**: 265. 1958.
*clonocystis* W. Gams *in* Persoonia **9**: 132. 1976.
*cystojenkinii* W. Gams & Veenbaas-Rijks *in* Persoonia **9**: 137. 1976.
*dichotoma* Linnem. *in* Flora **130**: 215. 1936 (nom. inval., Art. 36).
**M. dichotoma** Linnem. ex W. Gams, *spec. nov.* Mortierellae elongatae Linnem. similis, sed sporangiophoris angustioribus, cito procumbentibus, 200 — amplius 750 µm longis, e 5–6 (–10) µm sursum ad 2–4 µm angustatis, irregulariter quasi dichotomice ramosis differt. Sporangia 20–40 µm diam., dilapsa collare minimum relinquunt. Sporangiosporae ellipsoideae vel breviter cylindricae, plerumque 4–7 × 2.5–4 µm. Chlamydosporae elongatae vel irregulares, 5–10 µm diam. Typus: CBS 221.35, isolatus ex excrementis murinis prope Marburgum in Germania a *G. Linnemann*. Nov. 1933.
*echinosphaera* Plaats-Niterink *in* Persoonia **9**: 91. 1976.
*echinula* Linnem. *in* Zentbl. Bakt. ParasitKde (II. Abt.) **107**: 229. 1953; Gams *in* Persoonia **9**: 117. 1976.

*echinulata* Harz *in* Bull. Soc. imp. Nat. Moscou **44**: 145. 1871. — *M. polycephala* var. *echinulata* (Harz) Linnem., Mucorineen-Gatt. *Mortierella*: 30. 1941.

*elongata* Linnem., Mucorineen-Gatt. *Mortierella*: 43. 1941. Z.: Gams *& al. in* Trans. Br. mycol. Soc. **58**: 5. 1972.

*elongatula* W. Gams & Domsch *in* Persoonia **9**: 119. 1976.

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S.: *M. indica* B. S. Mehrotra *in* Indian Phytopath. **13**: 68. 1960.

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*M. spinosa* sensu Milko, Opredel. mukoral. Gribov: 78. 1974.

*fimbricystis* W. Gams *in* Persoonia **9**: 138. 1976.

*gamsii* Mil'ko, Opredel. mukoral. Gribov: 76. 1974. Z.: Kuhlman *in* Mycologia **67**: 680. 1975.

S.: *M. spinosa* Linnem. *in* Flora **130**: 214. 1936 (nom. inval., Art. 36).

? *M. mutabilis* Linnem., Mucorineen-Gatt. *Mortierella*: 51. 1941.

*M. candelabrum* Tiegh. & LeMonn. sensu Gams *in* Nova Hedwigia **18**: 12. 1970 ('1969').

*gemmifera M. 'Ellis' in* Trans. Br. mycol. Soc. **24**: 95. 1940. Gams *in* Persoonia **9**: 121. 1976. Z.: Ellis (l. c.).

S.: *M. 'Ellis'* Linnem., Mucorineen-Gatt. *Mortierella*: 44. 1941.

*globalpina* W. Gams & Veenbaas-Rijks *in* Persoonia **9**: 113. 1976.

*globulifera* Rostrup *in* Dansk bot. Ark. **2**(5): 2. 1916; Turner *in* Trans. Br. mycol. Soc. **39**: 291. 1956. Z.: Kuhlman *in* Mycologia **64**: 325. 1972.

S.: *M. ericetorum* Linnem. *in* Zentbl. Bakt. ParasitKde( II. Abt.) **107**: 228. 1953.

*horticola* Linnem., Mucorineen-Gatt. *Mortierella*: 21. 1941.

*humilis* Linnem. *in* Flora **130**: 209. 1936 (nom. inval., Art. 36). Z.: Chien *& al. in* Mycologia **66**: 118. 1974.

**M. humilis** Linnem. ex W. Gams, *spec. nov.* Coloniae rapide crescunt et fortiter olent. Sporangiophora basitone ± ramosa, 50–200 µm longa, e 2–4 sursum ad circa 1 µm angustata. Sporangia constanter monospora, 6–15 µm diam., pariete externo verruculoso firme adhaerente, dilapsa nonnumquam collare minutum relinquunt. Species heterothallica; zygosporae inter hyphas compatibiles appropinquantes formantur, hyalinae, leves nec involutae; pariete 2–6 µm crasso circumdatae, (34–)46(–62) µm diam.; alteri suspensores ad diametrum zygosporae similem inflati. Chlamydosporae absunt. Typus: CBS 222.35, isolatus e terra prope Marburgum in Germania, a *G. Linnemann*, 1934.

*hyalina* (Harz) W. Gams *in* Nova Hedwigia **18**: 13. 1970 ('1969'). — *Hydrophora hyalina* Harz *in* Bull. Soc. imp. Nat. Moscou **44**: 144. 1871.

S.: *M. candelabrum* var. *minor* Grove *in* J. Bot. Lond. **23**: 131. 1885.

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*jenkinii* (A. L. Sm.) Naumov, Opredel. Mukorovych (Mucorales) (Ed. 2): 97. 1935. — *M. bainieri* Cost. var. *jenkinii* A. L. Sm. *in* J. Bot., Lond. **36**: 180. 1898. Gams *in* Persoonia **9**: 135. 1976.

*kuhlmanii* W. Gams *in* Persoonia **9**: 122. 1976. Z.: Kuhlman *in* Mycologia **64**: 325. 1972 (as *M. 'elongata'*).

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S.: *M. sepedonioides* Linnem., Mucorineen-Gatt. *Mortierella*: 23. 1941.

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*macrocystis* W. Gams *in* Nova Hedwigia **3**: 69. 1961. — *M. microspora* Wolf var. *macrocystis* (W. Gams) Linnem. apud Zycha & Siepm., Mucorales: 208. 1970 ('1969').
*minutissima* Tiegh. *in* Annls Sci. nat. (Bot.) VI **4**: 385. 1876. Z.: Kuhlman *in* Mycologia **64**: 325. 1972.
*nana* Linnem., Mucorineen-Gatt. *Mortierella*: 16. 1941.
S.: *M. alba* Mańka & Gierczak *in* Pr. Kom. Nauk. roln. Leśn., Poznań **9**: 17. 1961.
*nantahalensis* Chien *in* Mycologia **63**: 826. 1971.
*oligospora* Björling *in* Bot. Notiser 1936: 121.
*ornata* W. Gams 1978, in preparation.
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*parvispora* Linnem., Mucorineen-Gatt. *Mortierella*: 53. 1941. Z.: Gams & Williams *in* Nova Hedwigia **5**: 347. 1963.
S.: *M. gracilis* Linnem., Mucorineen-Gatt. *Mortierella*: 38. 1941.
*pilulifera* Tiegh. *in* Annls Sci. nat. (Bot.) VI **1**: 105. 1875.
*polycephala* Coemans *in* Bull. Acad. r. Belg. (Cl. Sci.) II **15**: 536. 1863. Turner & Pugh *in* Trans. Br. mycol. Soc. **44**: 246. 1961. Z.: Dauphin *in* Annls Sci. nat. (Bot.) IX **8**: 47. 1908.
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? *M. microspora* Wolf, l. c.: 528. 1954.
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*sarnyensis* Mil'ko *in* Nov. Sist. niz. Rast.: 87. 1973. Gams *in* Persoonia **9**: 119. 1976.
S.: ?*M. fatshederae* Linnem. apud Zycha & Siepmann, Mucorales: 205. 1970 ['1969'] (nom. inval., Art. 37).
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*verrucosa* Linnem. *in* Zentbl. Bakt. ParasitKde (II. Abt.) **107**: 227. 1953. Gams *in* Persoonia **9**: 118. 1976.

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S.: *M. marburgensis* Linnem. *in* Flora **130**: 211. 1936 (nom. inval., Art. 36).
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*zonata* Linnem. *in* Flora **130**: 210. 1936 (nom. inval., Art. 36).
S.: ?*M. insignis* Linnem., Mucorineen-Gatt. *Mortierella*: 34. 1941.
**M. zonata** Linnem. ex W. Gams, *spec. nov.* Mortierellae humili Linnem. ex W. Gams similis, sed sporangiis monosporis levibus vel minute verruculosis, membrana laxe adhaerente obtectis, 10–17(–25) µm diam. differt. Sporangiophora 80–200 µm alta, e 5–6(–10) µm sursum ad 1–2 µm angustata. Sporangia dilapsa collare minutum relinquunt. Chlamydosporae parcae, minutae, ovales. Zygosporae ignotae. Typus: CBS 228.35, isolatus e Gomphidio glutinoso, Kirchspitze prope Marburgum in Germania, a *G. Linnemann*, Aug. 1934.
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