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NEMATODE-TRAPPING SPECIES OF *DACTYLELLA* AND *MONACROSPORIUM*

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(With 4 Text-figures)

Three new species of *Monacrosporium* are described which capture nematodes in adhesive networks, *M. cystosporum*, *M. salinum* and *M. fusiformis*. *M. megalosporum* (Drechsler) Subram. is reported for the first time in Britain. The taxonomy of known nematode-trapping species of *Dactylella* and some species of *Dactylaria* is discussed. Nine species of *Dactylella* and one of *Dactylaria* are transferred to *Monacrosporium*.

Many species of nematode-trapping fungi with conidiophores bearing solitary, multiseptate, terminal conidia have been described and placed in *Dactylella* Grove (Cooke & Godfrey, 1964). In a recent paper Subramanian (1964) discussed the status of the two closely related genera *Dactylella* Grove and *Monacrosporium* Oudemans. He pointed out that if *Dactylella* were based on *D. minuta* Grove (1884) and *M. elegans* Oudemans (1885) were taken as the lectotype of *Monacrosporium* then a convenient and logical separation of the two genera might be made. Both genera produce phragmospores singly and acrogenously at the apex of simple conidiophores. In the case of *M. elegans* Oudem., one of the cells of the conidium is much longer and wider than the other cells, while in *D. minuta* Grove this character is not present (Fig. 4C). Subramanian separated the two genera on this character. Eleven taxa of nematode-trapping fungi were then transferred to *Monacrosporium*. Ten of these had previously been placed in *Dactylella* and one, mistakenly called *Dactylella eudermata* by Subramanian, in *Dactylaria* Sacc. These were as follows:

M. bembicodes (Drechsler) Subram. (*Dactylella bembicodes* Drechsler, 1937.)
M. lysipagum (Drechsler) Subram. (*D. lysipaga* Drechsler, 1937).
M. gephyropagum (Drechsler) Subram. (*D. gephyropaga* Drechsler, 1937).
M. heterosporum (Drechsler) Subram. (*D. heterospora* Drechsler, 1943).
M. coelobrochum (Drechsler) Subram. (*D. coelobrocha* Drechsler, 1947).
M. aphrobrochum (Drechsler) Subram. (*D. aphrobrocha* Drechsler, 1950).
M. stenobrochum (Drechsler) Subram. (*D. stenobrocha* Drechsler, 1950).
M. cionopagum (Drechsler) Subram. (*D. cionopaga* Drechsler, 1950).
M. megalosporum (Drechsler) Subram. (*D. megalospora* Drechsler, 1954).
M. phymatopagum (Drechsler) Subram. (*D. phymatopaga* Drechsler, 1954).
M. eudermatum (Drechsler) Subram. (*Dactylaria eudermata* Drechsler, 1950).

All the above species are characterized by somewhat fusoid conidia with two or more transverse septa and with one of the cells, usually intermediate, markedly wider and longer than the others.

A further confusion in the placing of nematode-trapping hyphomycetes in *Dactylella* has arisen through the existence of species which produce their conidia mainly in the solitary state but occasionally form them singly on short branches arising from the conidiophore, usually near its apex. Species with this weakly capitate habit have been placed in an arbitrary manner, sometimes in *Dactylella*, as with *D. asthenopaga*, *D. leptospora* Drechsler (1937) and *D. megalospora* Drechsler (1954), and sometimes in *Dactylaria*, for example *D. psychrophila* Drechsler (1944) and *D. eudermata* Drechsler (1950). When conidiophore branching does occur it is so infrequent and so feebly expressed, there being rarely more than 2–3 branches, that the simple conidiophore must be considered the typical form and these species are best placed in the same genera as consistently solitary spored species and not considered as depauperate forms of *Dactylaria*.

Eleven solitary spored species of nematode-trapping fungi now remain in *Dactylella* or *Dactylaria*. Eight of these have fusoid to turbinate conidia with two or more transverse septa and one of the intermediate cells wider and longer than the rest. Using Subramanian's criterion these may now conveniently be transferred to *Monacrosporium*. Very full descriptions of all these species are given in the original publications.

Monacrosporium ellipsosporum (Grove) comb.nov.

Basionym: *Dactylella ellipsospora* Grove (*J. Bot., Lond.*, **24**, 200, 1886).

Monacrosporium doedycoides (Drechsler) comb.nov.

Basionym: *Dactylella doedycoides* Drechsler (*Mycologia*, **32**, 456, 1940).

Monacrosporium psychrophilum (Drechsler) comb.nov.

Basionym: *Dactylaria psychrophila* Drechsler (*Mycologia*, **36**, 161, 1944).

Monacrosporium reticulatum (Peach) comb.nov.

Basionym: *Dactylella reticulata* Peach (*Trans. Br. mycol. Soc.* **33**, 148, 1950).

Monacrosporium mammilatum (Dixon) comb.nov.

Basionym: *Dactylella mammilata* Dixon (*Trans. Br. mycol. Soc.* **35**, 144, 1952).

Monacrosporium turkmenicum (Soprunov) comb.nov.

Basionym: *Dactylella turkmenica* Soprunov (*Ashkabad. Acad. Nauk. Turkman.*, p. 148, 1958).

Monacrosporium parvicollis (Drechsler) comb.nov.

Basionym: *Dactylella parvicollis* Drechsler (*Sydowia*, **15**, 13, 1962).

Monacrosporium drechsleri (Tarjan) comb.nov.

Basionym: *Dactylella drechsleri* Tarjan (*Mycopath. Mycol. appl.* **14**, 143, 1961).

Three nematode-trapping species of *Dactylella*, *D. lobata* Duddington (1951), *D. asthenopaga* Drechsler (1937) and *D. leptospora* Drechsler (1937) have fusoid conidia lacking a noticeably larger intermediate cell (Fig. 4A, B, D). These species can remain in this genus. A key for separating all the above species may be found elsewhere (Cooke & Godfrey, 1964).

Four species of *Monacrosporium* have been described which trap nematodes in adhesive networks. These are *M. psychrophilum* Drechsler (1944), *M. eudermatum* Drechsler (1950), *M. reticulatum* Peach (1950) and *M. megalosporum* Drechsler (1954). Three new species with the same type of trap have recently been isolated, together with *M. megalosporum* which was found for the first time in Britain but which was different in some respects from the species described by Drechsler. In the following study the fungi were grown on nematode-infested rabbit dung agar (RDA) (Duddington, 1955), and in pure culture on Difco corn-meal agar (CMA).

Monacrosporium megalosporum (Drechsler) Subram.

This species was described by Drechsler (1954) on nematode-infested agar as producing solitary conidia which were broadly fusoid, elongate-ellipsoidal or obovoid, 57·5–70μ long, 24–35μ wide, 2–5 but predominantly 4-septate, distally rounded and tapering to a narrow truncate base. The conidia had a strongly ventricose shape due to distension of the median cell and the delimiting wall at the truncate basal end was 'modified by a lump-like deposit of opaque material'. In pure culture on corn-meal agar conidia were sometimes produced singly and terminally on 1–5 spurs 10–40μ long arising from the conidiophore apex and were 40–60μ long, 17–25μ wide with 2-, 3-, and 4-septate forms often present in equal numbers together with a few 5-septate conidia.

A fungus subsequently identified as *M. megalosporum* was isolated from soil from Coombesdale, Derbyshire. Unlike the fungus described by Drechsler its conidia on both RDA and CMA were invariably borne in a solitary state on simple conidiophores. On RDA conidia were elongate-ellipsoidal 40–75μ long, 18–35μ wide and 1–4 but mainly 4-septate (Fig. 2A). On CMA conidia were similar in shape to those on RDA, 40–60μ long, 17·5–25μ wide and 1–4 but mainly 3-septate (Fig. 2B). They were not strongly ventricose (Fig. 1B) and had no deposit of opaque material at their bases. Despite the differences noted above between this fungus and Drechsler's original description of *M. megalosporum* it seems clearly to be the same species.

Monacrosporium cystosporum sp.nov.

Mycelium hyalinum, hyphae septatae, ramosae, praesentibus vermiculis nematodeis laqueos hyphales, vel curvos vel circulares, saepe in retia larga auctos. Hyphae fertiles, erectae, septatae, in apice plerumque 1 nonnunquam 2–3 conidia capitata gerentes.

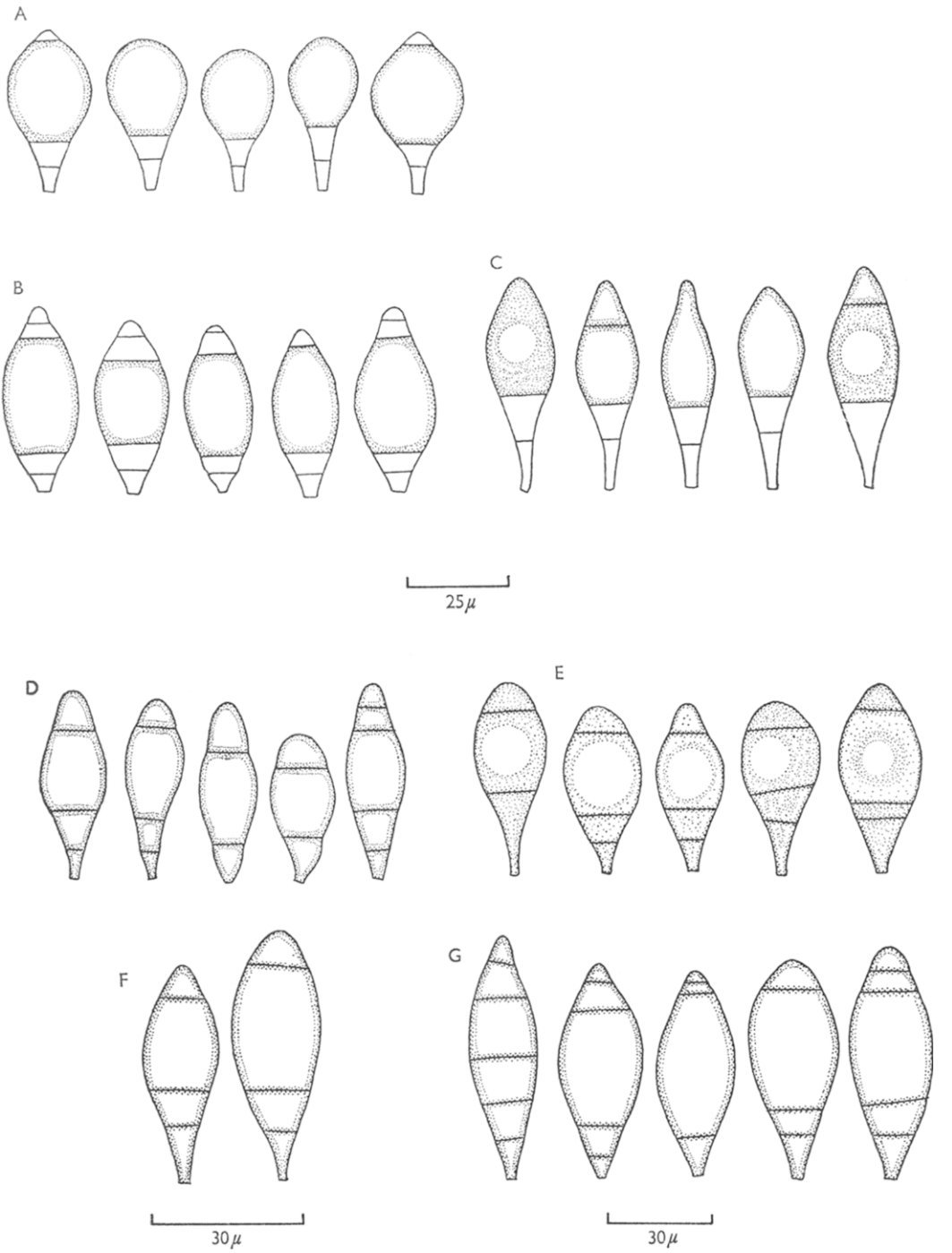

Fig. 1. Conidia of A, *Monacrosporium cystosporum* on CMA; B, *M. megalosporum* on CMA; C, *M. fusiformis* on CMA; D, *M. salinum* on CMA; E, *M. salinum* on RDA; F, '*M. psychrophilum*' after Duddington (1951); G, *M. psychrophilum* after Drechsler (1944).

Conidia hyalina, late clavata vel turbinata, 0–3 plerumque 2-septata, 32·5–50μ longa, 14–22·5μ lata, apice rotundata, sensim ad basem tenuem, truncatam minuentia. Illaqueans et consumens vermiculos nematodeos in terra prope Bogor, Java. Typus culturus **IMI** 109554 est.

This species was isolated from soil from the Botanic Gardens, Bogor, Java. Conidia were usually borne singly and terminally on simple conidiophores, but sometimes the latter were branched sparingly at the apex and

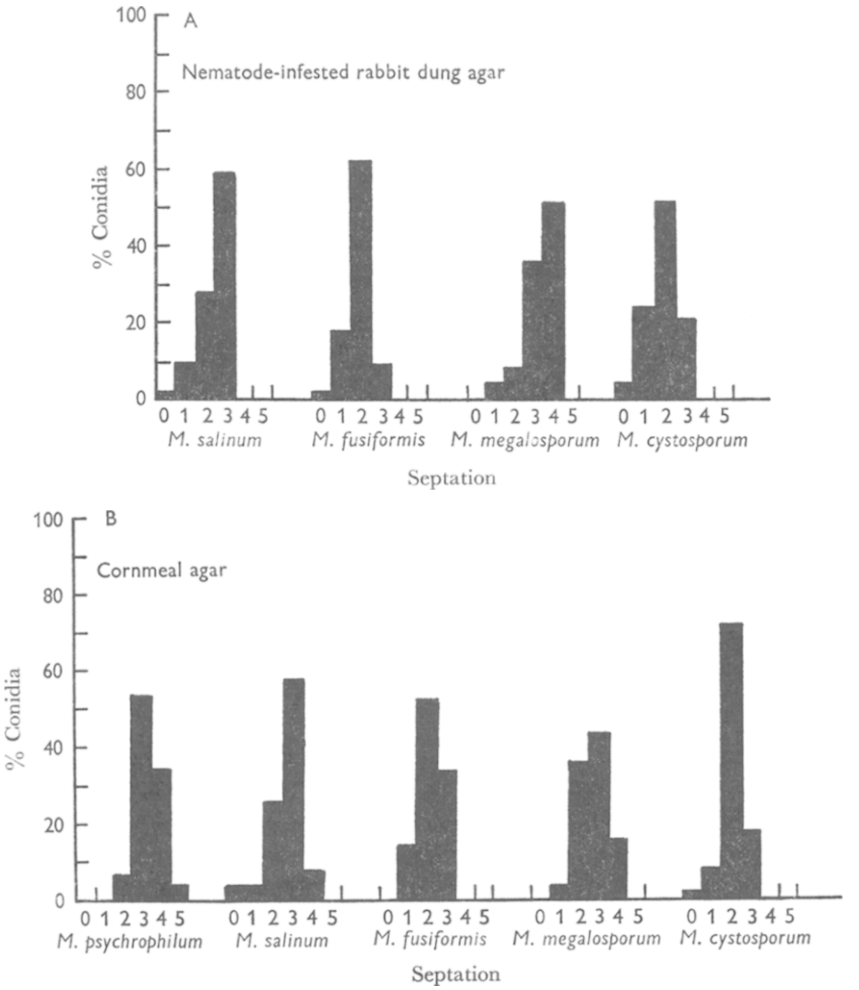

Fig. 2. Variation in septation of conidia of *Monacrosporium* spp. A, On nematode infested rabbit dung agar; B, on cornmeal agar. Data from 50 conidia selected at random. Data for *M. psychrophilum* from Drechsler (1944).

2–3 conidia were each borne singly and terminally on these branches which were about 30μ long. On RDA conidia were broadly clavate or broadly turbinate to obovoid (Fig. 1A) 32·5–50μ long, 14–22·5μ wide, 0–3 but mainly 2-septate (Fig. 2A) with an almost globose terminal or

subterminal cell. They were distally rounded and tapered to a long 'tail' formed by the two basal cells, the proximal one being narrowly truncate.

In pure culture on CMA conidia were 35–50 μ long, 15–22·5 μ wide, 0–3 but predominantly 2-septate (Fig. 2B) and differed little in shape from those produced on RDA.

The new species seems to be closely related to *M. eudermatum* Drechsler (1950), but spores of the latter were described as being much larger, 37–55 μ long and 21–35 μ wide, although Drechsler does not make it clear whether these measurements were based on conidia from pure cultures or on nematode-infested media. Furthermore, conidia were commonly 3-septate with the large globose terminal or subterminal cell having a thick wall and containing a prominent vacuole. These characters were absent in the new species. *M. eudermatum* was also described as producing a copious and felt-like mycelium on corn-meal agar. On CMA the new fungus formed a sparse, flat mycelium typical of most of the nematode-trapping hyphomycetes.

The paucity of conidiophores with groups of capitate conidia suggests that the species is better placed in *Monacrosporium* Oudem. than in *Dactylaria* Sacc. The specific epithet refers to the bladder-like terminal or subterminal cell of the conidium.

Monacrosporium salinum sp.nov.

Mycelium hyalinum, hyphae septatae, ramosae, praesentibus vermiculis nematodeis laqueos hyphales, vel curvos vel circulares, saepe in retia larga auctos. Hyphae fertiles, erectae septatae, in apice unicum conidium gerentes. Conidia hyalina, ellipsoidea vel obconica, 0–3 plerumque 3-septata, 39–52·5 μ longa, 15–20 μ lata, apice rotundata, sensim ad basem tenuem, truncatam minuentia. Illaqueans et consumens vermiculos nematodeos in paludis salsae humo Gibraltar Point, Lincolnshire, Anglia. Typus culturus **IMI** 109555 est.

This fungus was isolated from fruits of *Halimione portulacoides* (L.) Aell. from Gibraltar Point, Lincs. Conidia were almost invariably borne in a solitary state at the apices of simple conidiophores. On RDA conidia were ellipsoidal to obovate (Fig. 1E) 39–52·5 μ long, 15–20 μ wide and 0–3 but mainly 3-septate (Fig. 2A). They were rounded distally, tapered proximally to a narrow, truncate base and had a large subterminal cell which contained a prominent vacuole. In pure culture on CMA the conidia became markedly different in shape being fusoid-ellipsoidal (Fig. 1D) 32·5–52·5 μ long, 12·5–17·5 μ wide and 0–4 but mainly 3-septate (Fig. 2B).

This species resembles *M. psychrophilum* Drechsler (1944), but conidia of the latter were described as being larger. They were 46–71 μ long and 21–29 μ wide, these measurements being from pure cultures on corn-meal agar. Measurements of length and breadth for 50 conidia of the new species from a pure culture on CMA fell well outside the size range of conidia of *M. psychrophilum* given by Drechsler (Fig. 3). Although the latter were predominantly 3-septate (Fig. 2B) there was a large proportion of 4-septate and even some 5-septate individuals. Conidia of *M. psychrophilum* figured by Drechsler (Fig. 1G) differ in shape from those of the new species which frequently had a 'tail' formed from the long proximal cells. In contrast to *M. psychrophilum* few 4-septate spores were formed by the new

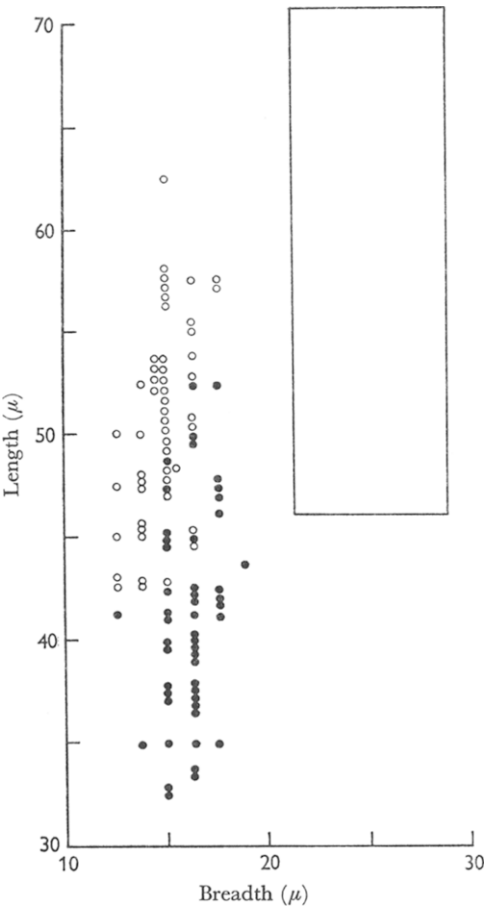

Fig. 3. Distribution of conidium size in *M. salinum*, *M. fusiformis* and *M. psychrophilum* on CMA. ○, *M. fusiformis*; ●, *M. salinum*. The rectangle delimits the range of conidium size in *M. psychrophilum* as described by Drechsler (1944). Size differences between all three species are significant at $P = < 0{\cdot}001$.

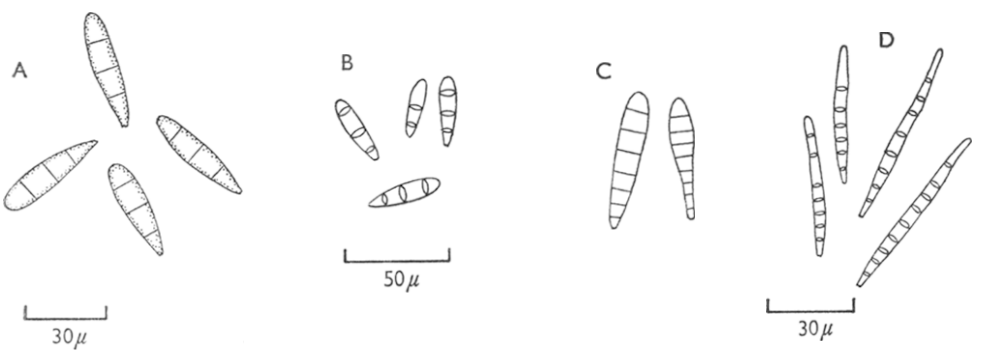

Fig. 4. Conidia of A, *Dactylella lobata*; B, *D. asthenopaga*; C, *D. minuta*; D, *D. leptospora*; A, redrawn after Duddington; B and D, redrawn after Drechsler; C, redrawn after Grove.

species on CMA, and on RDA there were none at all. *M. psychrophilum* was reported by Drechsler as sometimes forming loose capitate groups of conidia each arising singly at the apex of a conidiophore branch about 35 μ long. Such an arrangement was never found in the new species on the two standard media. Duddington (1951*a*) described a fungus as *M. psychrophilum* which had conidia of a similar size and shape as *M. salinum* (Fig. 1 F). On nematode-infested agar, conidia were 42–52 μ long and 19–24 μ wide and in pure culture on corn-meal agar, 39–52 μ long and 15–21 μ wide. They were nearly always 3-septate and in old cultures were formed on sparingly branched conidiophores. It seems unlikely that this was *M. psychrophilum* but unfortunately no culture is available for examination. *M. psychrophilum* has almost certainly been found in Britain (Webster, 1954). Conidia on nematode-infested corn-meal agar were 46–70 μ long, 18–20 μ wide, 2–6 but apparently mostly 3–4-septate and always borne in a solitary state. Despite this, there is fair agreement in size, shape and septation with Drechsler's description.

The ecology of this new species is of interest, as records of nematode-trapping fungi from marine situations are few, and the fungi have been rarely related to any natural microhabitat in this environment. The presence of this fungus on decaying bracteoles of *Halimione*, a common salt marsh plant, is perhaps an indication of the role of some of the fungi isolated from sea water by the usual trapping methods.

Monacrosporium fusiformis sp.nov.

Mycelium hyalinum, hyphae septatae, ramosae, praesentibus vermiculis nematodeis laqueos hyphales, vel curvos vel circulares, saepe in retia larga auctos. Hyphae fertiles, erectae, septatae, in apice plerumque 1, nonnunquam 2 conidia capitata gerentes. Conidia hyalina, fusoideo-ellipsoidea, 0–3 plerumque 2 septata, 30–50 μ longa, 12·5–17·5 μ lata, sensim ad basem tenuem, truncatam minuentia. Illaqueans et consumens vermiculos nematodeos in terra prope Pattingham, Shropshire, Anglia. Typus culturus **IMI** 109553 est.

This fungus was isolated from soil from Pattingham, Shropshire. Conidia were mostly formed in a solitary state on the apices of simple conidiophores but sometimes two conidia were formed on a conidiophore, each terminal on a branch about 15 μ long at the conidiophore apex. On RDA conidia were fusoid to fusoid-ellipsoidal (Fig. 1 C) 30–50 μ long, 12·5–17·5 μ wide, 0–3 but mainly 2-septate (Fig. 2 A) with a large terminal or subterminal cell which sometimes contained a prominent vacuole. In pure culture on CMA conidia were a similar shape to those formed on RDA. They were 42·5–62·5 μ long, 12·5–17·5 μ wide, 1–3 but mainly 2-septate with a large proportion of 3-septate individuals (Fig. 2 B).

This fungus is obviously closely related to *M. psychrophilum* and *M. salinum* but the dimensions of its conidia with their distinctly different fusoid shape and septation distinguishes it from them. Measurements of length and breadth of 50 conidia of the new species on CMA fell well outside the size range of *M. psychrophilum* given by Drechsler, and though there was some overlap in spore length with *M. salinum* there was a significant difference between the two species (Fig. 3).

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