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Nematophagous fungi from soils of Iraq

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Fifteen taxa of nematode-trapping fungi were isolated from soil samples collected in Iraq. Among them, seven taxa belonged to *Arthrobotrys*, two to each of *Dactylella*, *Dactyleria*, *Monacrosporium*, and one to *Stylopage* and *Cystopage*. The trapping devices of each fungal species were recognized. A brief description of each species from pure cultures is provided. All the reported taxa are new to Iraq.

Key words: nematode-trapping fungi, soil fungi, Iraq.

INTRODUCTION

Nematophagous fungi are capable of trapping or destroying nematodes in soil by different trapping devices (Dackman, Jannson and Nordbring-Hertz 1992). Recently, three types of this group have been recognized: nematode-trapping, endonematophagous and nematode-cysts parasitic fungi (Nordbring-Hertz 1988). The most extensive study on the nematode-trapping fungi has been conducted by Cook and Godfrey (1964), Jarowaja (1970) and Barron (1977). Although, several investigations have been carried out regarding the ecology and biology of these fungi (Gray 1985; Lackey, Jaffe and Muldoon 1992; Jaffe 1993; Jannson 1993, 1994), little attention has been paid to their taxonomy (Cook and Godfrey 1964; Jarowaja 1970; Barron 1977). This is the first report on the morphology of the nematode-trapping fungi from soils of Iraq.

MATERIALS AND METHODS

A total of 308 soil samples were collected from different localities in Iraq in the years 1995–1996. Soil samples were taken from the depth of 15–25 cm, placed in plastic bags and subsequently brought to the laboratory. Isolation of fungi was made using 2% water agar in Petri dishes by sprinkling 0.5 g of each soil sample on the surface of agar medium and incubating at 23°C. Petri dishes were examined after 5–7 days for any fungi growth. Pure cultures were made for each of fungal isolate.

Fungal identification and description were made following Drechsler (1933, 1934, 1950), Cook and Godfrey (1964), Barron (1977), Matsushima (1975), Domsch et al. (1980).

DESCRIPTIONS AND DISCUSSION

Fifteen taxa of nematode-trapping fungi were isolated during this study. Seven species belonged to the genus *Arthrobotrys*, two species to each of *Dactylella*, *Dactyleria*, *Monacrosporium*, *Stylopage* and one species to

Table 1
Nematode-trapping fungi and their trapping devices

Fungal taxa	Trapping devices
Arthrobotrys arthrobotryoides	Adhesive nets
A. cladodes var. *cladodes*	Adhesive nets
A. cladodes var. *macroides*	Adhesive nets
A. conoides	Adhesive nets
A. dactyloides	Constricting rings
A. longispora	Adhesive nets
A. oligospora	Adhesive nets
Cystopage sp.	Adhesive hyphae
Dactylella brochopaga	Constricting rings
D. leptospora	Adhesive knobs and nonconstricting rings
Dactyleria haptotyla	Adhesive knobs
D. sclerohypha	Adhesive knobs
Monacrosporium eudermatum	Adhesive nets
M. parvicollis	Adhesive knobs
Stylopage grandis	Adhesive hyphae

Cystopage. In additions one unidentified taxon was isolated. The trapping devices of each isolated fungus were recognized as given in Table 1. It appeared that there were six types of trapping structures, which the recovered species had developed: adhesive hyphae, adhesive branches, adhesive nets, adhesive knobs, non- constricting rings and constricting rings (Figs 1–14). Most of the species were described in "Mycologia" published in the years 1937–1950. In the present article three species were described in more detail, as original works are virtually unobtainable.

Arthrobotrys arthrobotryoides (Berl. ex Lindau) Drechsler Mycologia 36: 138–171 (1944). Figs 15–16.

Colony pale yellow, hyphae hyaline, septated, 2–5 μm diam. Conidiophores erected, 350–675 × 3–6 μm. Conidia hyaline, oval shape, 19–27 × 9–14 μm size, with one septum, apical cell slightly larger than the basal cell, conidia are formed along the conidiophore.

Isolate examined: from soil, Basrah, 25 Dec. 1995. Slide No. 160.

The isolated species is similar to *A. oligospora* except the conidia are produced in clusters on the conidiophores in the latter species while in *A. arthrobotryoides* the conidia are produced along the conidiophore (D o m s c h et al. 1980).

A. cladodes var. *cladodes* Drechsler Mycologia 29: 449–459 (1937). Fig. 17.

Colony hyaline, hyphae hyaline, septated, 2–5 μm diam. Conidiophores erected, septated, branched, 200–330 × 5–6.5 μm. Conidia hyaline, cylindrical, 12–18 × 6–8 μm size, with one septum, equal cells.

Isolate examined: from soil, Basrah, 30 Jan. 1995. Slide No. 81.

The isolate of this variety is identical with those of *A. cladodes* var. *macroides* in most of morphological characters. However, the conidia size is smaller in var. *cladodes* than in var. *macroides* (D r e c h s l e r 1937).

A. cladodes var. *macroides* Drechsler Mycologia 36: 138–171 (1944). Fig. 18.

Colony hyaline, hyphae hyaline, septated, 3–5 μm diam. Conidiophores errected, septated, branched, 250–400 × 4.5–7.5 μm. Conidia hyaline, cylindrical, 15–21 × 5–10 μm size, with one septum and equal cells. Conidia are formed in clusters on the conidiophores. Chlamydospores present, 8–12 μm.

Isolate examined: from soil, Misan, 21 Oct. 1995. Slide No. 82.

The taxonomic relegation between both varietes is given under the former isolated fungus.

A. conoides Dreschler Mycologia 29: 447–554 (1937). Fig. 19.

Colony pale yellow, hyphae hyaline, septated, 2.5–6.5 μm diam. Conidiophores pale yellow, septated, 225–450 × 6–8 μm. Conidia hyaline, pyriform to clavate, 19–40 × 8–14 μm, one septum, constricted at the septum, apical cell larger than the basal cell, conidia are formed as a cluster on the apex of conidiophore.

Isolate examined: from soil, Basrah, 10 Feb. 1996. Slide No.65.

This species can be easily recognaized from the related one *A. longispora* by production of unbranched conidiophores and the conidia are produced at the end of conidiophore whereas in *A. longispora* the conidia are formed in clusters on branched conidiophores (D o m s c h et al. 1980).

A. dactyloides Drechsler Mycologia 29: 447–554 (1937). Fig. 20.

Colony hyaline, hyphae septated, 3–5 μm diam. Conidiophores errected, unbranched, 250–400 × 4–7 μm. Conidia hyaline, clavate, 30–40 × 6–10 μm, one septum, conidia are produced on denticles at the apex of conidiophore.

Isolate examined: from soil, Misan, 6 Oct. 1995. Slide No. 77.

Despite of some variations are present between the isolated fungus with the description of D r e c h s l e r (1937), however, all the criteria of our isolates are in conformity with C o o k and G o d f r e y (1964).

A. longispora Soprunov Acad. Sci Turkmen Ashabad 1: 365 (1958). Fig. 21.

Colony hyaline, hyphae septated, 2–4.5 μm diam. Conidiophores errect branched, 300–650 × 4–8 μm. Conidia hyaline, ellipsoidal to subclavate, 20–38 × 9–14 μm, one septum and constriction present, apical cell is larger than the basal cell.

Isolate examined: from soil, Basrah, 10 Nov. 1995. Slide No. 79.

The most closely related species is *A. conoides* and the taxonomic separation of these two species is given under the former isolates. The present isolates are exactly similar to those described by C o o k and G o d f r e y (1964).

A. oligospora Fres. Beitr. Mykol. 1–2 (1952). Fig. 22.

Colony and hyphae hyaline, 2.5–5 μm diam. Conidiophores septated, unbranched, 200–440 × 6–10 μm. Conidia oval shape, 22–34 × 8–15 μm, one septum near to the base, produce in clusters on the conidiophore.

Isolated examined: from soil, Nasyria, 10 Dec. 1996. Slide No.100.

The only difference between the examined species and the proposed *A. oligospora* (D o m s c h et al. 1980) is that the size of conidia, which are slightly smaller (20–27 × 8–15 μm) than the present isolates.

Cystopage sp. Trans. Br. Mycol. Soc. 47: 61–74 (1964). Fig. 23.

Colony hyaline, hyphae hyaline to pale green, coenocytic, 2–3.5 μm. No conidiophores and conidia are present.

Isolate examined: from soil, Misan, 10 Aug. 1995. Slide No. 159.

The isolated fungus did not produce conidia and conidophores in culture medium. This is agreed with Cook and Godfrey (1964). Two species are known in this genus and their taxonomic deposition is based upon the chlamydospores size. However, no chlamydospores are formed in culture of this isolated taxon.

Dactylella brochopaga Drechsler Mycologia 29: 445–554 (1937). Fig. 24.

Colony hyaline, hyphae hyaline, septated, 3–5 μm diam. Conidiophores unbranched, 200–350 μm. Conidia hyaline, cylindrical, 24–40 × 5–8 μm, with 1–3 septa, conidia with denticle at the point of attachment with conidiophore.

Isolate examined: from soil, Nasyria, 17 Feb. 1996. Slide No. 99.

This species has been filed under the genus *Dactyleria* by Drechsler (1937) then it has been transferred to the genus *Dactylella* by Cook and Godfrey (1961) and later on by Matsushima (1975).

D. leptospora Drechsler Mycologia 29: 447–554 (1937). Fig. 25.

Colony hyaline, hyphae hyaline, septated, 1.5–3 μm diam. Conidiophores errected, branched, 150–250 × 1.5–3 μm. Conidia hyaline, fusiform, 25–77 × 3–5 μm, with 5–9 septa, adhesive knobe present at one end of each conidium, 6–9 μm diam.

Isolate examined: from soil, Basrah, 23 Jan. 1996. Slide No. 102.

The major character of this species is the presence of adhesive knobe at the end of the conidium. This feature of the present isolate is in conformity with the designated species *D. leptospora* (Drechsler 1937, Cook and Godfrey 1964).

Dactyleria heptotyla Drechsler Mycologia 42: 1–79 (1950). Fig. 26.

Colony hyaline, hyphae hyaline, 2–4 μm diam. Conidiophores errected, septated branched near the apex, 100–275 × 2.5–4 μm. Conidia hyaline, fusiform, 34–45 × 6–11 μm, with 3–5 septa, mostly 4 septa, middle cell slightly larger than the terminal cells.

Isolate examined: from soil, Nasyria, 22 Mar. 1995. Slide No. 112.

According to Drechsler (1950) the conidia size of this fungus reachs up to 55 × 13 μm whereas our isolates showing conidia never reach 45 × 11 μm size.

D. sclerohypha Drechsler Mycologia 42: 1–79 (1950). Fig. 27.

Colony hyaline, hyphae hyaline, septated, 2–4 μm diam. Conidiophores 175–300 × 2.5–3.5 μm. Conidia hyaline, fusiform, with pointed ends, 35–53 × 5–9 μm, 3–5 septa, one conidium only is produced on the apex of conidiophore.

Isolate examined: from soil, Nasyria, 20 Jan. 1996. Slide No. 129.

This species can be separated from *D. haptotyla* by production of single conidium at the apex of the conidiophore besides to some minor differences in conidial measurements.

Monacrosporium eudermatum (Drechsler) Subram. J. Indian Bot. Soc. 42: 291–300 (1963). Figs 28–29.

Colonies hyaline, hyphae hyaline to greenish, septated, 2–4 μm diam. Conidiophores unbranched, 260–400 μm. Conidia hyaline, oboval, 31–61 × 8–28 μm, with 3 septa, apical cell much larger than other cells, a single conidium is produced at the apex of the conidiophore.

Isolate examined: from soil, Basrah, 5 Dec. 1995. Slide No. 89.

This fungal species is common in the examined soil samples in this study. This species was erected as *Dactyleria eudermatum* (Drechsler 1950) and transferred into *Monacrosporium eudermatum* by Subramma-nian (1963) based on the large cell of the conidium.

M. parvicollis (Drechsler) Subram. J. Indian Bot. Soc. 42: 291–300 (1963). Figs 30–31.

Colony hyaline, hyphae hyaline, 3–5 μm diam. Conidiophores branched near the apex, 75–200 × 2.5–4 μm. Conidia hyaline, fusiform, 35–42 × 8–13 μm, with 3 septa, apical cell larger than the other cells, single conidium is produced.

Isolate examined: from soil, Nasyria, 25 Apr. 1996. Slide No. 105

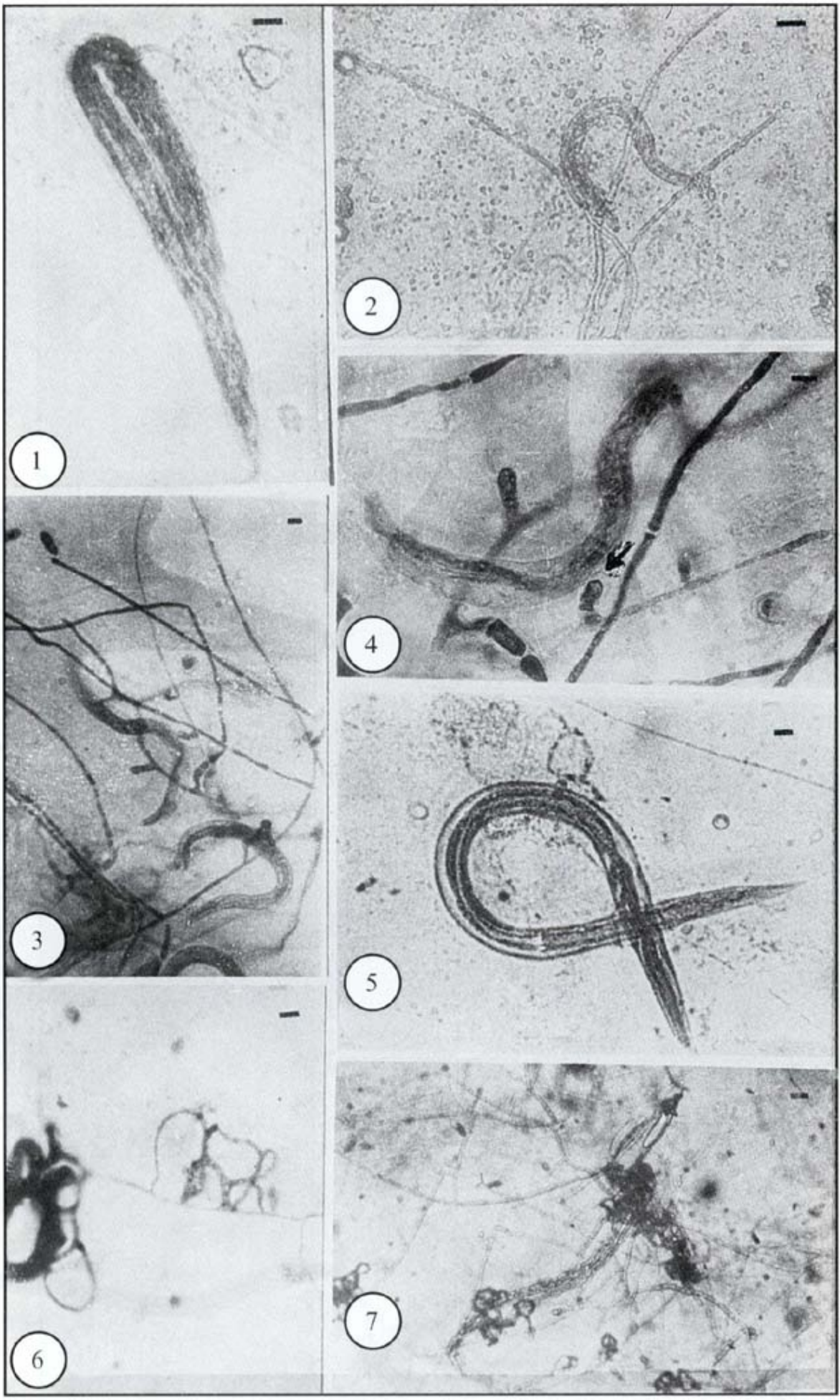
The main difference between *M. eudermatum* and *M. parvicollis* is the size of the conidia. The relegation of these two species is followed as stated by Cook and Godfrey (1964).

Stylopage grandis Duddington Mycologia 47: 245–248 (1955). Fig. 32.

Colony hyaline, coenocytic, 2.5–4 μm diam. Conidiophores branched, 275–475 × 3–4 μm. Conidia hyaline, oval, 20–70 × 13–28 μm, a single conidium is formed on the conidiophore.

Isolate examined: from soil, Basrah, 23 Jan. 1996. Slide No. 69.

This species is simply recognized from *S. hadra* by the absence of the globular protuberance at the point of attachment with the nematode body as described by Duddington (1955).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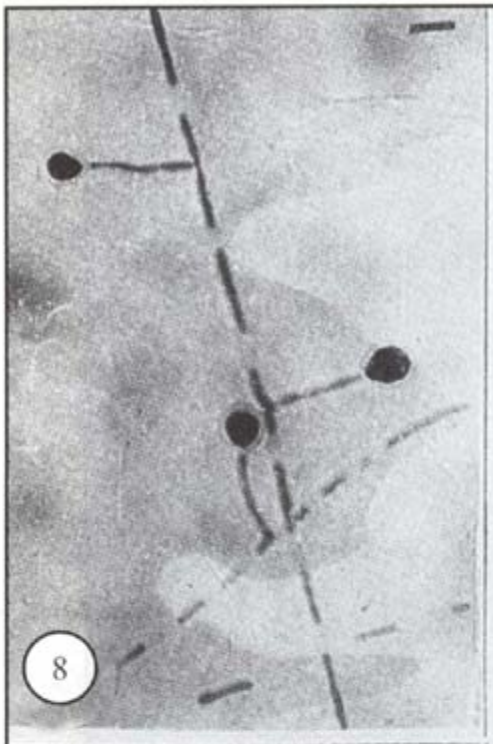
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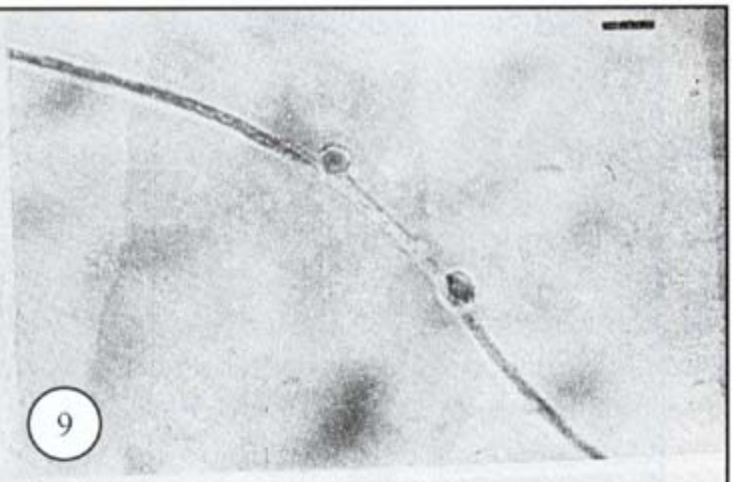
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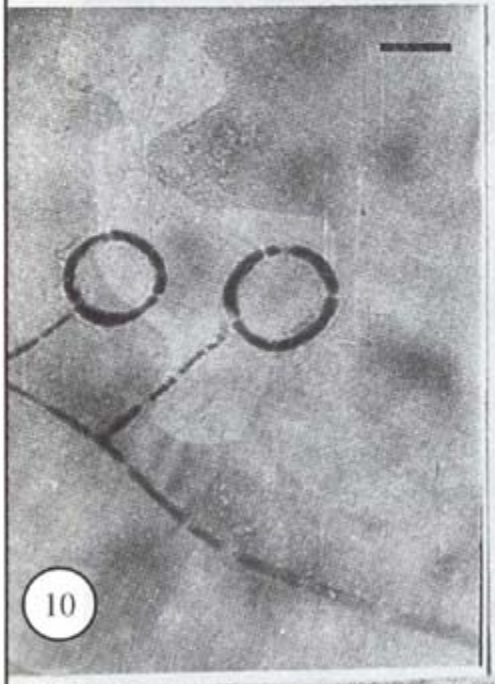
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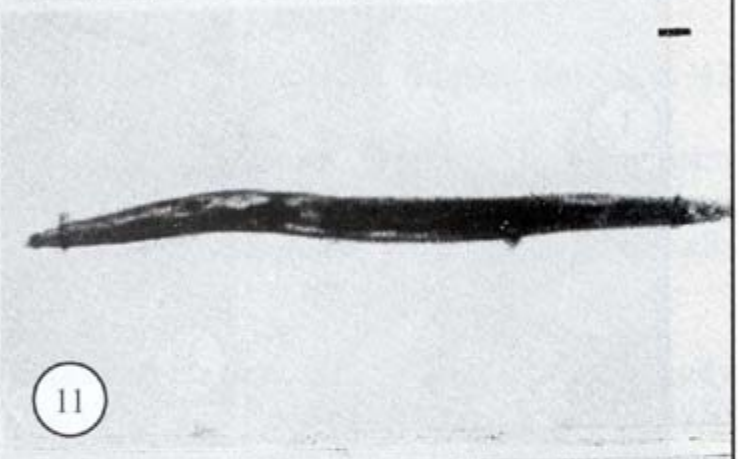
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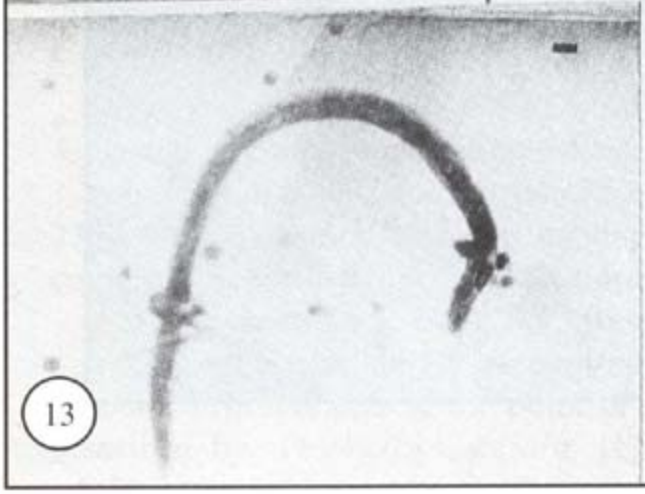
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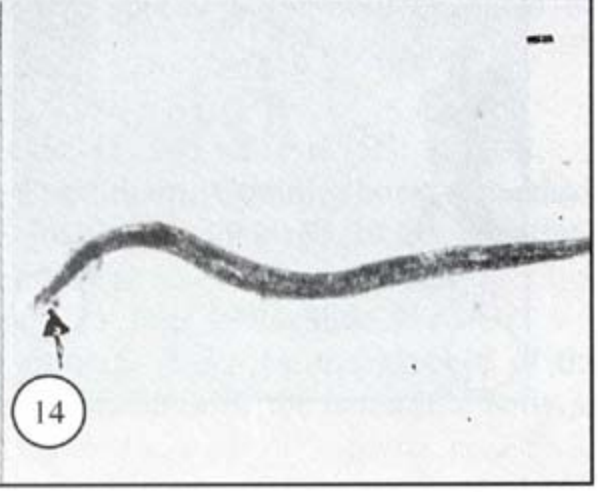
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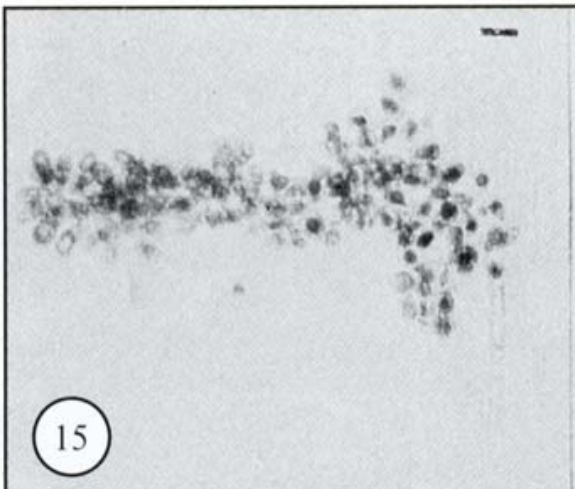
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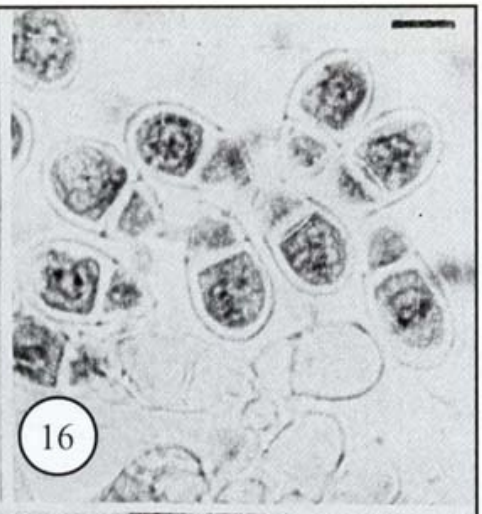
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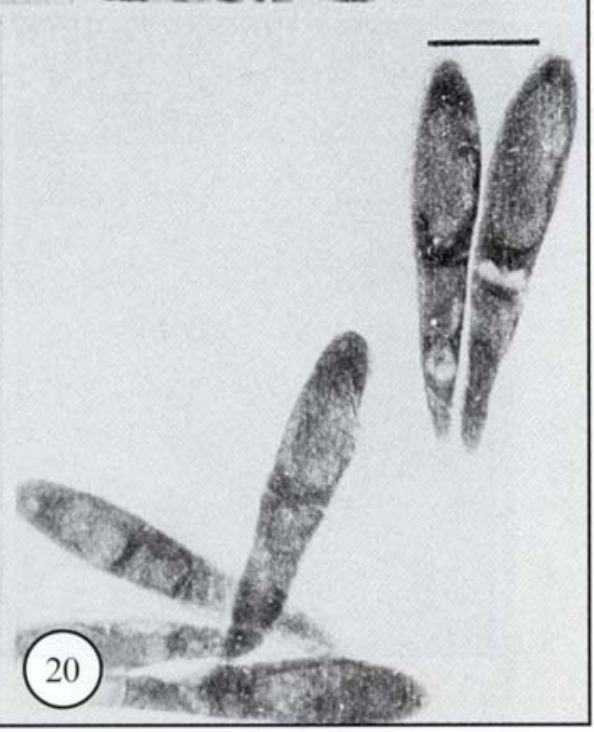
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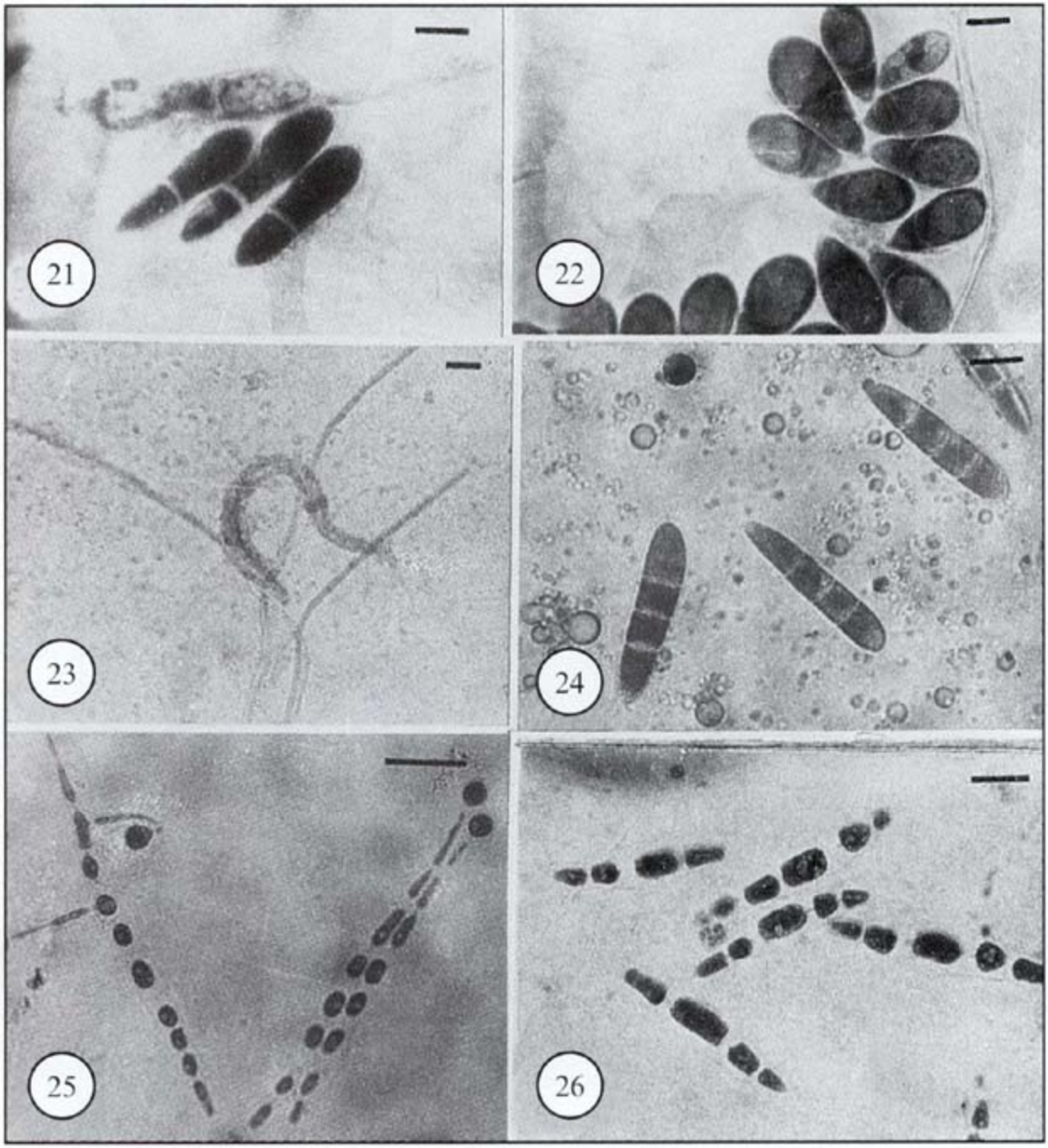
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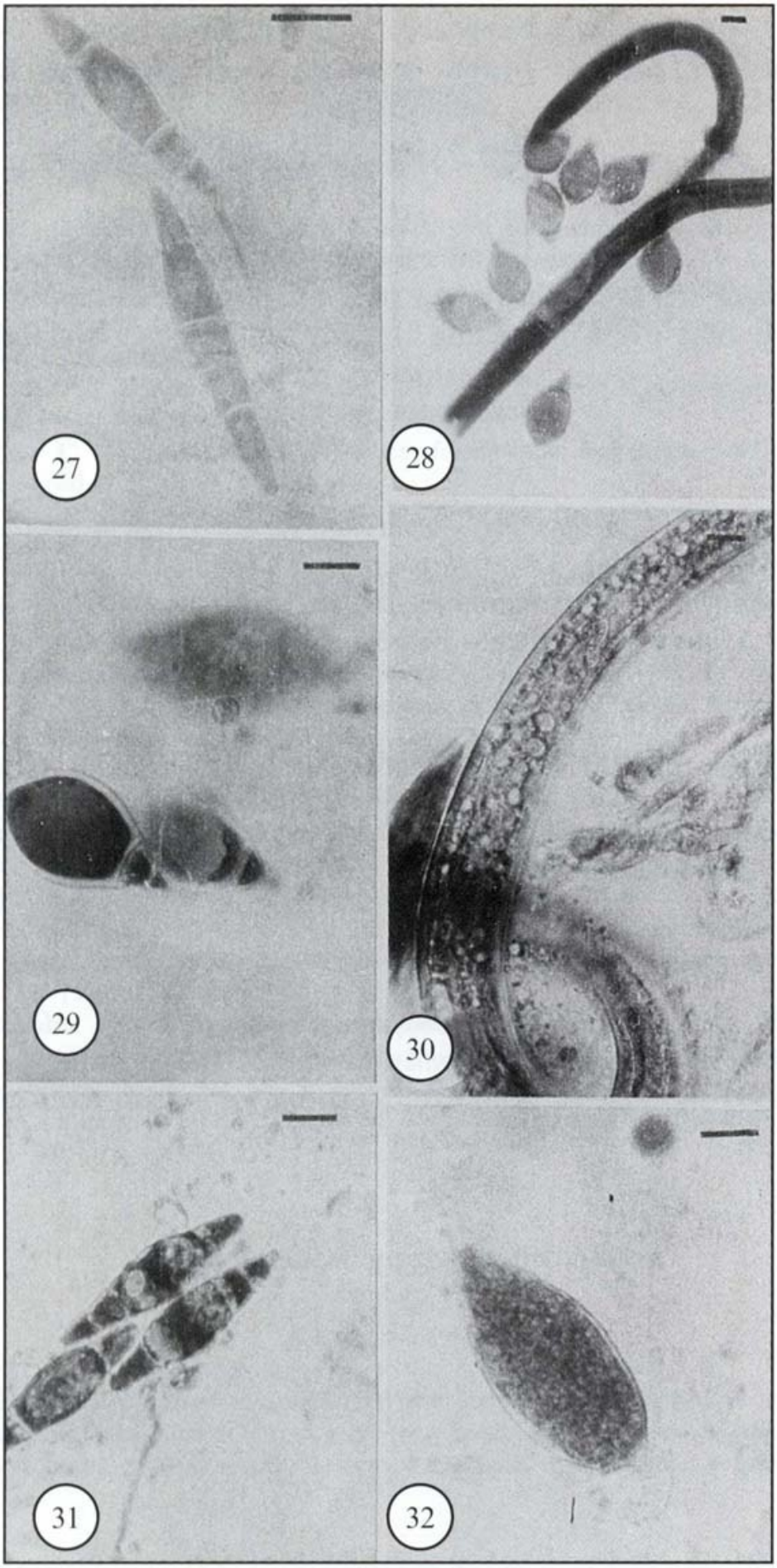
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Figs 1–7: 1–2. Nematode trapped by fungal adhesive hyphae, 3–4. Nematode trapped by adhesive hyphal branches, 5–7. Nematode trapped by adhesive nets
(Scale bare = 105 μm)

Figs 8–14: 8. Hyphae showing adhesive stalked knobs, 9. Hypha with sessile adhesive knob, 10. Non-constricting ring, 11. Nematode trapped with non-constricting ring, 12. Constricting ring, 13–14. Nematodes trapped with constricting ring
(Scale bare = 10 μm)

Figs 15–20: 15–16. *Arthrobotrys arthrobotryoides*, 17. *Arthrobotrys cladodes* var. *macroides* (conidia), 18. *Arthrobotrys cladodes* var. *cladodes* (conidia), 19. *Arthrobotrys conoides* (conidia), 20. *Arthrobotrys dactyloides* (conidia)
(Scale bare = 10 μm)

Figs 21–26: 21. *Arthrobotrys longispora* (conidia), 22. *Arthrobotrys oligospora* (conidia), 23. *Cystopage* sp. (nematode trapped by adhesive hyphae), 24. *Dactylella brochopaga* (conidia), 25. *Dactylella leptospora* (conidia with adhesive knobs), 26. *Dactyleria haptotyla* (conidia)
(Scale bare = 10 μm)

Figs 27–32: 27. *Dactyleria sclerohypha* (conidia), 28–29. *Monacosporium eudermatum* (conidia), 30–31. *Monacosporium parvicollis* (conidia; nematode trapped by adhesive knobs), 32. *Stylopage grandis* (conidium)
(Scale bare = 10 μm)

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Nicieniobójcze grzyby z gleb Iraku

Streszczenie

Artykuł zawiera wykaz 15 taksonów grzybów opanowujących nicienie w glebie w trzech miejscowościach w Iraku. Obecność tych grzybów w kraju o ciepłym klimacie zanotowano po raz pierwszy. Wyróżniono przy tym kilka sposobów „łapania" tych zwierząt w pułapki.

Errata. The author's name read T. M. MUHSIN in Acta Mycologica 32 (1): 41–50.