

## Some Dematiaceous Hyphomycetes on Decomposing Leaves of *Satakentia liukuensis* from Ishigaki Island, Japan

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### Summary

Twelve species of dematiaceous hyphomycetes were isolated from decomposing leaves of the palm *Satakentia liukuensis*. Their morphological characteristics both on natural substrates and in culture are described and illustrated. Taxonomic problems of these fungi encountered in this study are discussed.

Keywords: hyphomycetes, palm, *Satakentia liukuensis*.

*Satakentia liukuensis* (Hats.) H. F. Moore is an endemic palm tree inhabiting the Sakishima Islands (Ishigaki Is. and Iriomote Is.). It is thought to harbor subtropical and tropical microfungi on its decomposing leaves, but little attention (12) has been paid to these. We had opportunities to collect samples of fallen decomposing leaves (including leaf sheath, petioles and peduncles) of the palm tree from Yonehara, Ishigaki Is., Okinawa Pref., on 31 Jan. 1991 and 27 Jan. 1994. After incubating the leaves in moist chambers for 1-2 months, we identified 12 species of dematiaceous hyphomycetes, some of which are new records from Japan, and obtained their cultures, which are deposited in the IFO culture collection. Morphology of the fungi on natural substrates and in culture and their cultural characteristics are described here and taxonomic problems encountered in the course of species identification are discussed briefly.

1. *Brachysporiella arengae* (Matsushima) Hol. -Jech., Ceska Mykol. 37: 14, 1983.  
( $\equiv$  *Sporidesmium arengae* Matsushima, "Icones Microfungorum a Matsushima lectorum" p. 136, 1975.)

Fig. 1A-G

Colonies on dead petioles effuse, velvety, dark brown to black. Conidiophores simple, septate, erect, moderate brown, paler toward apex, 70-408  $\mu$ m long, 7-11  $\mu$ m wide at the base, 4-5  $\mu$ m wide at the apex. One conidium is formed holoblastically at the apex of the main stalk of the conidiophore. After the secession of the conidium, the conidiogenous cell proliferates through the scar and produces a terminal conidium. Then, from the basal cell of the proliferation a lateral extension which curves sharply

downward and tapers toward the apex grows adpressed to the main stalk of the conidiophore. The basal cell of the recurving hypha produces a lateral extension ( $10-40 \times 3-4 \mu\text{m}$ ) which bears a terminal conidium. Often additional extensions grow out from the 2nd (and 3rd) basal cell of the recurving hypha. This branch formation is often repeated at each apex of the conidiogenous cell after secession of the conidium. Simple proliferation also occurs resulting successive terminal conidium formation. Conidia obovate, thick-walled, (2-) 3-septate, brown, slightly paler at the basal cell, with truncate basal scar, (20-)  $24-35 \times 10-15 \mu\text{m}$ .

Colonies on cornmeal agar (CMA) hyaline to gray olivaceous, extending up to 36-40 mm in diam at  $25^\circ\text{C}$  in 36 days. Hyphae hyaline to light brown, mostly immersed,  $1.5-4 \mu\text{m}$  wide. Conidiophores  $66-320 \mu\text{m}$  long,  $5-8 \mu\text{m}$  wide at the base,  $3-5 \mu\text{m}$  at the apex. Conidium formation was the same as that on natural substrates. Conidia obovate, sometimes curved, thick-walled,  $24-40 \times 13-18 \mu\text{m}$ , (1-) 2-3-septate, sometimes obliquely septate. Chlamydo spores formed laterally or intercalary on creeping hyphae immersed in the medium, globose to obovate, brown, verrucose, 1-2-celled,  $9-16 \times 8-10 \mu\text{m}$ . Ascumatal initials (?) or sclerotia-like structures were produced in CMA after 40 days' incubation. They were spherical, up to  $320 \mu\text{m}$  in diam, with surface wall texture intricata,  $4-6 \mu\text{m}$  thick, pale brown to brown. They often burst and exposed the inside pseudoparenchymatous tissue composed of hyaline round cells,  $4-8 \mu\text{m}$  in diam. No ostiole opening was observed. Incubation on potato carrot agar (PCA), potato sucrose agar (PSA), V-8 juice agar (V-8A) and oatmeal agar (OA) with or without sterilized corn or banana leaves did not induce maturation (ascus and ascospore formation) of the structure.

Specimen examined: IFO H-12179, from dead petiole, 31 Jan. 1991.

Cultures examined: IFO 32657 (AN-1147) & AN-1146, monospore isolates derived from IFO H-12179.

This species has been reported on palms from Japan (Ishigaki Is.), New Zealand, Cuba, Peru (7, 9, 12, 16, 21), but this is the first report that this species produces chlamydo spores and ascumatal initial-like structures in culture.

## 2. *Circinotrichum falcatisporum* Pirozynski, Mycol. Pap. 48: 7, 1962.

Fig. 2A-J

Colonies on dead leaves effuse, hairy to velvety, dark brown to black. Mycelia composed of branched, brown to olivaceous hyphae,  $1.5-3 \mu\text{m}$  in diam, superficially creeping on the substrate, bearing conidiogenous cells (phialides) and two types of setae, straight and circinate. Straight setae erect, thick-walled, fewer than circinate setae, dark brown, paler and tapering toward apex, roughened with tubercles,  $260-400 \mu\text{m}$  long,  $6-8 \mu\text{m}$  wide at the base,  $2-3 \mu\text{m}$  wide at the apex, septate but not apparent due to densely pigmented and thickened wall. Circinate setae erect, curved at the upper part, dark brown, with rough surface,  $180-320 \mu\text{m}$  high,  $4-5 \mu\text{m}$  wide at the base,  $1.5-3 \mu\text{m}$  at the apex, septate. Conidiogenous cells phialidic, pleurogenous on the repent hyphae, pyriform, thin-walled, hyaline,  $5-7 \mu\text{m}$  long,  $2.5-4 \mu\text{m}$  wide at the base. Conidia falcate, with acute ends, non-septate, hyaline,  $16-23 \times 1.5-2 \mu\text{m}$ , produced successively.

Colonies on CMA hyaline to white, gray olivaceous at the center, extending up to 18–21 mm in diam at 25°C in 25 days. Hyphae 1–4  $\mu\text{m}$  wide, hyaline, tuberculate in thick hyphae. Straight and circinate setae erect, brown, 120–200  $\mu\text{m}$  long, 4–5  $\mu\text{m}$  wide at the base, 2–3  $\mu\text{m}$  wide at the apex, 5–8-septate, rough. Phialide-like projections are formed laterally on creeping hyphae, clavate or pyriform, 4–8  $\times$  3–4  $\mu\text{m}$ , with a septum at the base. No conidium was produced on the projections.

Specimens examined: IFO H-12180, from dead leaf sheath, 31 Jan. 1991; IFO H-12181, from dead leaf sheath, 27 Jan. 1994.

Cultures examined: IFO 32658 (AN-1368) & AN-1369, monospore isolates derived from IFO H-12181; AN-1141 (monospore isolate) & AN-1142 (mass spore isolate), derived from IFO H-12180.

Conidia adhere together in large masses at the apex of phialides. Mucilage often surrounds the lower part of the conidial mass and the apices of phialides, which might lead to misunderstanding that the conidiogenous cells proliferate percurrently and form annulations at their apex (19). Phialidic conidium formation and mucilage exudation was also observed in *Gyrothrix circinata* (Berkeley & Curtis) Hughes by the present authors (18).

3. *Codinaea simplex* Hughes & Kendrick, New Zealand J. Bot. 6: 362, 1968.

Fig. 3A–H

Colonies on dead petioles effuse, gray olivaceous. Mycelia composed of semi-immersed, light brown to brown hyphae. Conidiophores simple, rarely branched, erect from repent hyphae, straight or geniculate in accordance with conidiophore proliferation, brown, paler toward apex, 64–120  $\mu\text{m}$  long, 3.5–4  $\mu\text{m}$  wide at the base. Conidiogenous cells phialidic, integrated, with funnel-shaped collarettes. Proliferation occurs just below or through the apical collarette. After successive proliferation, several collarettes remain on the side and apex of conidiophore, resulting in polyphialidic appearance. Conidia falcate, curved, nonseptate, hyaline, 13–19  $\times$  2–3  $\mu\text{m}$  ( $\bar{x}$  = 16.4  $\times$  2.2  $\mu\text{m}$ ), with a delicate hair-like appendage, 6–8  $\mu\text{m}$  long, at each end. Conidia accumulate in slimy drop on phialides.

Colonies on CMA dull green to gray olivaceous, extending up to 25–27 mm in diam at 25°C in 24 days. Hyphae light brown, 1.5–4  $\mu\text{m}$  wide. Conidiophores simple or branched, elongate up to 840  $\mu\text{m}$  long by successive (more than 20 times) proliferation, 4–6  $\mu\text{m}$  wide at the base, brown, paler toward apex. Conidiogenous cells similar to those on natural substrates. Conidia falcate, non-septate, hyaline, 12–19  $\times$  2–3  $\mu\text{m}$  ( $\bar{x}$  = 15.1  $\times$  2.5  $\mu\text{m}$ ), with or often without a hair-like appendage, 1–8  $\mu\text{m}$  long.

Specimen examined: IFO H-12182, from dead petiole, 27 Jan. 1994.

Cultures examined: IFO 32659 (AN-1366) & AN-1367, monospore isolates derived from IFO H-12182.

4. *Coleodictyospora cubensis* Charles, *Phytopathol.* 19: 1051, 1929. Matsushima, *Mats. Myc. Mem.* 5: 8, 1987, supplemented the latin diagnosis.

Fig. 4A-F

Colonies on dead petioles forming sporodochia, dark brown to black. Sporodochia black, 300  $\mu\text{m}$  high, 400  $\mu\text{m}$  in diam. Conidiophores simple, sometimes branched, extending from cushion-shaped basal mat, up to 120  $\mu\text{m}$  long, 1-5  $\mu\text{m}$  wide, septate, hyaline. Conidia transversely oblong, produced holoblastically and laterally on conidiophores, slightly constricted at the middle where conidiophore attaches, muriform, with (7-) 9-11 transverse septa and 1-3 longitudinal septa, (28-) 35-48  $\times$  (13-) 15-19  $\mu\text{m}$  ( $\bar{x}$  = 40.9  $\times$  16.4  $\mu\text{m}$ ), light brown, enveloped in mucilaginous sheath, 36-60  $\times$  22-46  $\mu\text{m}$ .

Colonies on CMA olivaceous to gray olivaceous, extending up to 7-10 mm in diam at 25°C in 24 days, producing sporodochia with conidia after 2 months' incubation. Mycelia mostly immersed. Sporodochia dark brown to black, 100-560  $\mu\text{m}$  in diam. Conidiophores simple or brached, 12-104  $\mu\text{m}$  long, 3-5  $\mu\text{m}$  wide, septate, hyaline. Conidia transversely oblong, constricted at the middle, muriform, with (7-) 8-10 transverse septa and 1-3 longitudinal septa, 32-45  $\times$  15-18  $\mu\text{m}$  ( $\bar{x}$  = 40.0  $\times$  16.7  $\mu\text{m}$ ), light brown, enveloped in mucilaginous sheath, 40-46  $\times$  26-44  $\mu\text{m}$ .

Specimen examined: IFO H-12183, from dead petiole, 27 Jan. 1994.

Cultures examined: IFO 32660 (AN-1378), AN-1379 & AN-1380, monospore iso-

Table 1. Comparison of morphology between *Coleodictyospora* species and our specimens.

	<i>C. cubensis</i> <sup>1)</sup>	<i>C. micronesica</i> <sup>2)</sup>	this study
Conidiophores	70-85 $\times$ 3.5-5 $\mu\text{m}$ (on subst.)	lacking, but as conidiogenous cell, 2-8 $\times$ 3-4 $\mu\text{m}$ (on CMA)	< 120 $\times$ 1-5 $\mu\text{m}$ (on subst.) 12-104 $\times$ 3-5 $\mu\text{m}$ (on CMA)
Conidia	42-50 $\times$ 20-22 $\mu\text{m}$ (on subst.)	30-40 $\times$ 13-16 $\mu\text{m}$ (on subst.) 30-42 $\times$ 15-18 $\mu\text{m}$ (on CMA) 16-36 $\times$ 11-17 $\mu\text{m}$ (on V-8A) 17-32 $\times$ 9-16 $\mu\text{m}$ (on V-8A)	(28-) 35-48 $\times$ (13-) 15-19 $\mu\text{m}$ (on subst.) 32-45 $\times$ 15-18 $\mu\text{m}$ (on CMA)
Conidium envelopes	60 (?) - 55 $\times$ 40-45 $\mu\text{m}$ (on subst.)	present, but not measured	36-60 $\times$ 22-46 $\mu\text{m}$ (on subst.) 40-46 $\times$ 26-44 $\mu\text{m}$ (on CMA)
Conidium trans. septa	8-14	6-9	(7-) 9-11
Conidiophore attaching point	at the middle of conidium	at the middle to end of conidium	at the middle of conidium

<sup>1)</sup> From (2)

<sup>2)</sup> From (13, 15)

lates derived from IFO H-12183.

In the genus *Coleodictyospora* Charles, two species, *C. cubensis* and *C. micronesica* (Matsushima) Matsushima, have been assigned. Though our specimen showed somewhat intermediate morphological characteristics as shown in Table 1, we identified it as *C. cubensis* because it was closer to this species in morphology of conidia and conidiophores. However, the discord in conidial width and septal number of conidia with Charles' description (see Table 1) may suggest the presence of a new, third species in the genus. Further studies of many samples in culture are required.

5. *Drepanospora pannosa* Berkeley & Curtis, Grevillea 3: 105, 1875.

(= *Helicosporium pannosum* (Berk. & Curt.) Moore, Mycologia 49: 582, 1957.)

Fig. 5A-F

Colonies on dead petioles effuse, light brown, raising conidiophores abundantly. Conidiophores simple or branched, erect, septate, 72–200  $\mu\text{m}$  long, 6–9  $\mu\text{m}$  wide, brown, paler toward apex, with hyaline apical cell which elongates apically. Conidiogenous cells, pleurogenous on conidiophore, teeth-shaped, 2.5–5  $\times$  2–2.5  $\mu\text{m}$ . Conidia holoblastic, filiform, 2.5–4 (–6)  $\mu\text{m}$  wide, hyaline to light brown, loosely coiled (2.2–4.33 times) in a plane, slightly swollen at both ends, in coils of 30–54  $\mu\text{m}$  in diam, 26–34-septate.

Colonies on CMA citrine to olivaceous, extending up to 22–28 mm in diam at 25°C in 23 days, forming conidia after 2 months' incubation. Mycelia immersed or partly superficial. Hyphae subhyaline to brown, 1.5–8  $\mu\text{m}$  wide, smooth but verrucose on brown thick-walled hyphae. Conidiophores simple or sometimes branched, erect, septate, 66–340  $\mu\text{m}$  long, 5.5–7.5  $\mu\text{m}$  wide, brown, with hyaline apical cell which elongates apically. Conidiogenous cells pleurogenous on conidiophore and sometimes on creeping hyphae, teeth-shaped, 2.5–6  $\times$  2–3  $\mu\text{m}$ . Conidia holoblastic, filiform, 5–6 (–7)  $\mu\text{m}$  wide, hyaline to light brown, loosely coiled (2.25–4 times) in a plane, slightly swollen at both ends, in coils of 30–56 (–70)  $\mu\text{m}$  in diam, 26–31 (–41)-septate. Chlamydospore-like structures ['sclerote pedicelee' (see (10))] pleurogenous on creeping hyphae, globose, 12–20  $\mu\text{m}$  in diam, single or catenate, light brown to brown, with or without pedicel, 14–20  $\times$  5–7  $\mu\text{m}$ . The chlamydospore-like cells contain subglobose granules (spermatia?), 2–3  $\times$  2  $\mu\text{m}$ , and often release them outside.

Specimen examined: IFO H-12184, from dead petiole, 27 Jan. 1994.

Cultures examined: IFO 32661 (AN-1374) & AN-1375, monospore isolates derived from IFO H-12184.

Characteristics of our materials are close to the description of *Helicosporium nematosporum* Linder (10). However, the species was treated as a synonym of *H. pannosum* (20), and recently Goos (5) recognized *Drepanospora* as an adequate generic name for this species. *Tubeufia helicoma* (Phill. & Plowr.) Pirozinski is known as the teleomorph of this species (20), but it was not observed in this study.

6. *Exerticlava triseptata* (Matsushima) Hughes, New Zealand J. Bot. 16: 333, 1978.  
( $\equiv$  *Cordana triseptata* Matsushima, Icones Microfungorum a Matsushima lectorum, 39. 1975.)

Fig. 6A-K

Colonies on dead petioles effused, dark brown to black, composed of mostly immersed mycelia. Conidiophores solitary, erect, straight or slightly curved, septate, 230–330  $\mu\text{m}$  long, 9–11  $\mu\text{m}$  wide at the base, 6–7  $\mu\text{m}$  wide at the subapex, 8–10  $\mu\text{m}$  at the apex, dark brown, paler toward apex. Conidiogenous cells integrated. After the first conidium is produced on the apex of the conidiophore, the outer wall of the distal end of the conidiophore is fragmented and the hyaline conidiogenous cell is exposed to form conidia. Up to eight conidia are holoblastically produced successively on different loci of the conidiogenous cell, resulting in disc-shaped scars of conidium detachment over the whole surface of the conidiogenous cell. Often the conidiogenous cell proliferates one to two times and repeats successive conidial formation. Conidia broadly ellipsoid, brown, thick-walled, 3-septate, 26–35  $\times$  15–18  $\mu\text{m}$  ( $\bar{x}$  = 31.3  $\times$  16.3  $\mu\text{m}$ ), with the protuberance of a detachment scar at the proximal end.

Colonies on CMA white with gray olivaceous patches, extending up to 8–11 mm in diam at 25°C in 30 days. Mycelia superficial and partly submerged. Hyphae hyaline, 1.5–2.5  $\mu\text{m}$  in diam, often branching symmetrically. Conidiophores solitary or gregarious, straight or slightly curved, septate, 80–186  $\mu\text{m}$  long or up to 230  $\mu\text{m}$  long when proliferated, (3–) 6–12  $\mu\text{m}$  wide at the base, 5–8  $\mu\text{m}$  wide at the subapex, (5–) 7–10  $\mu\text{m}$  wide at the apex. Conidiogenous cells often proliferate. Conidia oval to broadly ellipsoid, brown, thick-walled, 3-septate, 22–33  $\times$  13–18  $\mu\text{m}$  ( $\bar{x}$  = 26.5  $\times$  15.3  $\mu\text{m}$ ).

Specimen examined: IFO H-12185, from dead petiole, 27 Jan. 1994.

Cultures examined: IFO 32662 (AN-1386) (isolate from a conidiophore) & AN-1385 (isolate from 3 conidia), derived from IFO H-12185.

Teleomorph was not observed in this study on both natural substrates and the medium, though Matsushima (14) reported *Chaetosphaeria hiugensis* Hino as an ascomycetous state of this fungus. Matsushima (12, 14) obtained isolates of this fungus from ascospores but not from conidia. We also found its conidia scarcely germinate on CMA. However, we succeeded in obtaining a few isolates from conidia and conidiophores after more than 30 trials of their monospores or monophore isolation. This low germination rate of conidia may suggest this fungus requires certain, unknown conditions for conidium germination in natural habitats. Conidium formation of this fungus is also peculiar as described above. Matsushima (12) originally assigned this species to the genus *Cordana* Preuss. However, Hughes (9) established a new genus *Exerticlava* and transferred two species, *C. vasiformis* Matsushima and *C. triseptata*, to the new genus. Carmichael et al. (1) pointed out the resemblance in conidium formation between the two species and *Cacumisporium* Preuss species. Conidiogenesis in the latter genus was considered by Cole and Samson (3) as 'sympodullophtialidic' *sense* Hammill (6)], resembling those of *Chloridium* Link and *Codinaea* Maire species. Therefore, the generic accommodation for these species is still unsettled. However, it is certain that the proliferation of conidiogenous cells newly found in *E. triseptata* provides evidence for its close

affinity with *E. vasiformis* (Matsushima) Hughes, which has proliferating conidiophores (12).

7. *Helicoma palmigenum* (Penzig & Saccardo) Linder, Ann. Mo. Bot. Gdn. 16: 306, 1929.

Fig. 7A-I

Colonies on dead petiole effuse, dark brown, raising erect conidiophores. Conidiophores simple, stout, solitary or gregarious, thick-walled, septate, dark brown, paler toward apex, 200–320  $\mu\text{m}$  long, 7–10  $\mu\text{m}$  wide, proliferating sympodially, resulting conidium-detachment scars on the side. Conidia holoblastic, filiform, 9–12  $\mu\text{m}$  ( $\bar{x}$  = 10.2  $\mu\text{m}$ ) wide, helicoid, 1.5–1.67 times tightly coiled in a plane, in coils of 27–36  $\mu\text{m}$  ( $\bar{x}$  = 31.7  $\mu\text{m}$ ) in diam, 13–15-septate, smooth, brown.

Colonies on CMA citrine to olivaceous, becoming black with age, extending up to 19–24 mm in diam at 25°C for 25 days. Mycelia mostly immersed. Hyphae subhyaline to brown, 2–4  $\mu\text{m}$  in diam, smooth, but becoming verrucose in brown hyphae. Conidiophores simple, stout, solitary or gregarious, thick-walled, septate, brown, 104–570  $\mu\text{m}$  long, 5.5–7.5  $\mu\text{m}$  wide, sympodially proliferating by pushing away the detaching scar of previously formed conidium with long intervals, resulting in 1–6 circular or semicircular scars of conidium detachment. Conidia holoblastic, filiform, 10–13  $\mu\text{m}$  ( $\bar{x}$  = 11.1  $\mu\text{m}$ ) wide, helicoid, 1.75–1.8 times tightly coiled in a plane, in coils of 33–40  $\mu\text{m}$  ( $\bar{x}$  = 36.4  $\mu\text{m}$ ) in diam, 12–14-septate, slightly constricted at septa, smooth, brown. Up to 7 conidia were produced according to the conidiophore proliferation.

Specimen examined: IFO H-12186, from dead petiole, 27 Jan. 1994. Cultures examined: IFO 32663 (AN-1372) & AN-1373, monospore isolates derived from IFO H-12186.

The length of conidiophores was found to be greatly variable, up to 570  $\mu\text{m}$ , especially in prolonged cultures, due to repetitive conidiophore proliferation, though Matsushima (11) described conidiophores of his materials on CMA as ranging from 60 to 140  $\mu\text{m}$  long.

8. *Helicomycetes lilliputeus* Moore, Mycologia 49: 583, 1957.

Fig. 8A-E

Colonies on dead petiole, effuse, light brown. Mycelia superficial, with aerial hyphae. Hyphae yellowish brown, 2.5–4  $\mu\text{m}$  in diam. Conidiophores simple or branched, erect or bent, 10–80 (–160)  $\mu\text{m}$  long, 3–5  $\mu\text{m}$  in diam at the base, 2–2.5  $\mu\text{m}$  at the apex, septate, tapering toward apex, light olive, subhyaline at the apex. Conidiogenous cells integrated on branches or sometimes on main axis of conidiophore, mono- or polyblastic, denticulate by sympodial proliferation. Conidia filiform, 2–3  $\mu\text{m}$  ( $\bar{x}$  = 2.8  $\mu\text{m}$ ), helicoid, 1.75–2.67 times coiled in a plane, in coils of 16–20  $\mu\text{m}$  ( $\bar{x}$  = 18.0  $\mu\text{m}$ ) in diam, hyaline to subhyaline, 9–13-septate, holoblastically produced on denticles.

Colonies on CMA citrine to olivaceous, extended up to 23–25 mm in diam at 25°C in 23 days. Conidia were produced only at the central part of colony. Hyphae branching often rectangularly, 1–3.5  $\mu\text{m}$  in diam, light brown. Conidiophores simple or bran-

ched, erect or bent, often arising from coiled repent hyphae, yellowish brown, 7–50 (–80)  $\mu\text{m}$  long, 3.5–5.5  $\mu\text{m}$  wide. Conidiogenous cells integrated, denticulate. Conidia filiform, 3–4.5  $\mu\text{m}$  ( $\bar{x}$  = 3.7  $\mu\text{m}$ ) wide, helicoid, 2–2.5 times coiled in a plane, in coils of 19–26  $\mu\text{m}$  ( $\bar{x}$  = 22.4  $\mu\text{m}$ ) in diam, hyaline to subhyaline, 9–17-septate.

Specimen examined: IFO H-12187, from dead petiole, 27 Jan. 1994.

Cultures examined: IFO 32664 (AN-1376) & AN-1377, monospore isolates derived from IFO H-12187.

The thickness of conidial filaments may vary greatly, possibly because aged conidia swell into thicker filaments as shown in the above dimensions in culture. The species key proposed by Goos (4) ascribed this fungus to *H. lilliputeus*. Among the recently described species, *H. casuarinae* Matsushima is close to this fungus. However, the simple conidiophores (no branching) and less frequent septation (4–9-septate) of *H. casuarinae* (14) distinguish it from *H. lilliputeus* and our material.

9. *Melanographium citri* (Frag. & Cif.) M. B. Ellis, Mycol. Pap. 93: 21, 1963.

Fig. 9A–H

Colonies on dead peduncle effuse, velvety, dark brown to black. Mycelia immersed. Stroma dark brown, 25–80  $\mu\text{m}$  thick. Conidiophores in loose fascicles arising from stroma, dark brown, subhyaline to hyaline at the apex, septate, 380–660  $\mu\text{m}$  long, 4–5  $\mu\text{m}$  wide at the base, 5–7  $\mu\text{m}$  wide at the subapex, tapering toward apex. Conidiogenous cells integrated, proliferate sympodially resulting in rachises. Conidia reniform or ellipsoid, dark brown, finely wrinkled, 14–18  $\times$  9–11  $\mu\text{m}$  ( $\bar{x}$  = 16  $\times$  10.2  $\mu\text{m}$ ), with a germ slit.

Colonies on CMA white to pale brown, extending up to 19–24 mm in diam at 25°C in 8 days. Only mononematous conidiophores were formed in culture. Conidiophores brown, paler toward apex, septate, 200–520  $\mu\text{m}$  long, 4–5  $\mu\text{m}$  wide at the base, 5–7  $\mu\text{m}$  at the subapex. Conidiogenous cells integrated, proliferate sympodially. Conidia reniform or ellipsoid, brown to dark brown, 13–17  $\times$  8–10  $\mu\text{m}$  ( $\bar{x}$  = 13.7  $\times$  9.2  $\mu\text{m}$ ), with a germ slit.

Specimen examined: IFO H-12188, from dead peduncle, 27 Jan. 1994.

Culture examined: IFO 32665 (AN-1387), mass spore isolate derived from IFO H-12188.

Conidial sizes are smaller in culture than on natural substrates.

10. *Piricauda cochinensis* (Subram.) M. B. Ellis, More Dematiaceous Hyphomycetes, p. 367, 1976.

( $\equiv$  *Petrakia cochinensis* Subram., Sydowia Beih. 1: 15, 1957.)

Fig. 10A–H

Colonies on dead petiole effuse, thin, brown. Mycelia superficial. Conidiophores absent or short, doliform or conical with depressed or cupulate apex, 2–10  $\mu\text{m}$  high, 5–8  $\mu\text{m}$  wide at the apex, 10–20  $\mu\text{m}$  wide at the base. Conidiogenous cells integrated or pleurogenous on repent hyphae, monotretic, with an apical pore formed by conidium detachment. Conidia variable in shape, subglobose or obconical to broad pyriform, dark brown to black, muriform, thick-walled, often verrucose around proximal end, with a circular depression at the proximal end which corresponds to the apical pore of the

conidiogenous cell, 44–74  $\mu\text{m}$  ( $\bar{x}$ =58  $\mu\text{m}$ ) high, 38–66  $\mu\text{m}$  ( $\bar{x}$ =51  $\mu\text{m}$ ) wide, with 4–11 filiform appendages. Conidia are easily released from conidiogenous cells and scattered on the surface of substrates. Appendages simple, cylindrical, straight, septate, brown, paler toward apex, with a blunt tip, 22–108  $\mu\text{m}$  long, 4–6  $\mu\text{m}$  wide at the base, 2.5–3  $\mu\text{m}$  wide at the apex, arising mostly from side and apical part of conidium.

Cultures on CMA woolly, white to olivaceous, extending up to 20–21 mm in diam at 25°C in 23 days. Conidia were formed after 3.5 months' incubation on CMA. Hyphae hyaline to light brown, 1–4  $\mu\text{m}$  wide, verrucose or tuberculose in aerial hyphae (possibly due to some exudate from hyphae), branching often rectangularly. Conidiophores absent. Conidiogenous cells pleurogenous on repent or aerial hyphae, globose to subglobose, 5–7  $\mu\text{m}$  in diam, brown. Conidia variable in shape, globose to subglobose or obconical to obovate or irregular shaped, often surrounded with a thin membrane possibly derived from an exudate from conidium or conidiogenous cell, 26–50  $\mu\text{m}$  ( $\bar{x}$ =35  $\mu\text{m}$ ) high, 19–30  $\mu\text{m}$  ( $\bar{x}$ =25  $\mu\text{m}$ ) wide, verrucose side and around proximal end, with 1–4 appendages. Appendages filiform, septate, 14–60  $\mu\text{m}$  long, 5–6  $\mu\text{m}$  wide at the base, 3–4  $\mu\text{m}$  wide at the apex.

Specimens examined: IFO H-12189, from dead petiole, 31 Jan. 1991; IFO H-12190, from dead petiole, 27 Jan. 1994.

Cultures examined: IFO 32666 (AN-1381) & AN-1382, monospore isolates derived from IFO H-12190; AN-1143, AN-1144 & AN-1145, monospore isolates derived from IFO H-12189.

**11. *Sporidesmium minigelatinosum*** Matsushima, *Microfungi of the Solomon Islands and Papua-New Guinea*, p. 58, 1971.

Fig. 11A-G

Colonies on dead petioles effuse, dark brown. Mycelia superficial on substrate but often climbing conidiophores of other fungi. Hyphae often verrucose, 1–3  $\mu\text{m}$  wide, pale brown to brown. Conidiophores simple, straight, erect, septate, 14–40  $\mu\text{m}$  long, 4–5  $\mu\text{m}$  wide at the base, 3–4  $\mu\text{m}$  wide at the apex, dark brown. Conidiogenous cells integrated, proliferate percurrently according to conidium formation. Conidia holoblastic, obclavate with truncate base, pale brown to brown, thick-walled, paler and thin-walled toward apex, 31–50  $\mu\text{m}$  long, 6–7  $\mu\text{m}$  wide, 10–12-septate, with a mucilage drop at the apex.

Colonies on CMA olivaceous to olivaceous black, extending 5–7 mm in diam at 25°C in 24 days. Hyphae verrucose or with waving surface, pale brown to brown, 2–3  $\mu\text{m}$  wide. Conidiophores simple, erect, septate, 12–52  $\mu\text{m}$  long, 4–7  $\mu\text{m}$  wide at the base, 3–3.5  $\mu\text{m}$  wide at the apex, dark brown. Conidiogenous cells proliferate percurrently. Conidia holoblastic, obclavate with truncate base, pale brown to brown, 38–64  $\mu\text{m}$  long, 6–7  $\mu\text{m}$  wide, 9–11-septate, with a mucilage at the apex.

Specimen examined: IFO H-12191, from dead petiole, 27 Jan. 1994.

Cultures examined: IFO 32667 (AN-1370) & AN-1371, monospore isolates derived from IFO H-12191.

12. *Sporoschisma saccardoii* Mason & Hughes in Hughes, Mycol. Pap. 31: 20, 1949.

Fig. 12A-H

Colonies on dead petiole sparse, dark brown. Mycelia superficial. Conidiophores simple, erect, solitary, scattered, septate but not clearly seen due to dense pigmentation, dark brown, cylindrical with swollen middle part, 212-248  $\mu\text{m}$  long, 7-9  $\mu\text{m}$  wide at the base, 12-20  $\mu\text{m}$  wide at the middle, 12-14  $\mu\text{m}$  wide at the apex. Conidiogenous cells integrated, phialidic with long collarette, enteroblastically forming a chain of conidia. Setae (capitate hyphae) claviform, erect, solitary or gregarious up to 4, arising from the base of conidiophore, septate, brown, paler toward apex, with swollen apex covered with mucilage, sometimes proliferate percurrently through the swollen head. Conidia formed in long chains, cylindrical, flattened or slightly inflated at the ends, 37-48  $\times$  11-13  $\mu\text{m}$  ( $\bar{x}$  = 43.4  $\times$  11.7  $\mu\text{m}$ ), 5-septate, with slightly dense pigmentation at the septa, smooth, end cells 4-6  $\mu\text{m}$  long, subhyaline, penultimate cells 7-9  $\mu\text{m}$  long, dark brown, median cells 8-11  $\mu\text{m}$  long, dark brown.

Colonies on CMA white, extending up to 18-21 mm in diam at 25°C in 14 days. Hyphae hyaline. Conidiophores simple, erect, solitary or often gregarious up to 4, 1-2-septate, dark brown, cylindrical with swollen middle part, 120-190  $\mu\text{m}$  long, 6-9  $\mu\text{m}$  wide at the base, 12-14  $\mu\text{m}$  wide at the middle, 11-13  $\mu\text{m}$  wide at the apex. Conidiogenous cells phialidic with long collarette. Setae (capitate hyphae) claviform, solitary or gregarious up to 6, arising from the repent hyaphe close to conidiophore, septate, light brown, with swollen apex covered with mucilage. Conidia formed in long chains, cylindrical, 26-41  $\times$  10-12 (-15)  $\mu\text{m}$  ( $\bar{x}$  = 34.7  $\times$  11.1  $\mu\text{m}$ ), (2-) 5-septate, without dense pigmentation at the septa, smooth, end cells 4-6  $\mu\text{m}$  long, subhyaline, penultimate cells 6-7  $\mu\text{m}$  long, dark brown, median cells 5-8  $\mu\text{m}$  long, dark brown. The first conidium from each conidiophore was bullet-shaped, 2-septate, with flattened base, apical and median cells dark brown, basal cells subhyaline. The second and successional produced conidia were cylindrical. No *Chalara*-type conidiophores were formed.

Specimen examined: IFO H-12192, from dead petiole, 27 Jan. 1994.

Cultures examined: IFO 32668 (AN-1364) & AN-1365, massspore isolates, derived from IFO H-12192.

*Sporoschisma saccardoii* was very close in morphology to *S. nigroseptata* D. Rao & R. Rao. For identification of our materials, the two species and our material were compared in their morphology (Table 2). Nag Raj and Kendrick (17) pointed out the following distinguishing characteristics between the two species: *S. nigroseptata* has darker and larger conidiophores, larger conidia with black bands masking central three septa and larger median cells. However, these characteristics other than the width of conidia were found to be variable in culture or on natural substrates and not useful to distinguish the two species (see Table 2). In conclusion, we identified our material as *S. saccardoii* because it possesses the following characters; absence of *Chalara*-type conidiophores and thinner conidia [10-12 (-15)  $\mu\text{m}$  ( $\bar{x}$  = 11.1  $\mu\text{m}$ ) wide in culture, 11-13  $\mu\text{m}$  ( $\bar{x}$  = 11.7  $\mu\text{m}$ ) wide on host]. However, further critical studies in culture are necessary to clarify the species definition so as to distinguish *S. saccardoii* from *S. nigroseptata*. No teleomorph was observed in this study, though Hughes (8) reported *Chaetosphaeria*

*coelestina* Hohnel as the teleomorph.

Table 2. Comparison of morphological characteristics among *Sporoschisma saccardoi*, *S. nigroseptata* and our materials.

	<i>S. saccardoi</i> <sup>1)</sup>	<i>S. nigroseptata</i> <sup>2)</sup>	this study
<b>Conidiophores</b>			
length	up to 210 $\mu\text{m}$	217–310 $\mu\text{m}$ 250–300 $\mu\text{m}$	212–248 $\mu\text{m}$ (on subst.) 120–190 $\mu\text{m}$ (on CMA)
width at base	10–16 $\mu\text{m}$	9–11 $\mu\text{m}$ 8–10 $\mu\text{m}$	7–9 $\mu\text{m}$ (on subst.) 6–9 $\mu\text{m}$ (on CMA)
width at middle	15–19 $\mu\text{m}$	up to 18 $\mu\text{m}$	12–20 $\mu\text{m}$ (on subst.) 12–14 $\mu\text{m}$ (on CMA)
width at apex	12–15 $\mu\text{m}$	16–20 $\mu\text{m}$ 16–19 $\mu\text{m}$	12–14 $\mu\text{m}$ (on subst.) 11–13 $\mu\text{m}$ (on CMA)
<b>Capitate setae</b>			
length	up to 150 $\mu\text{m}$	80–160 $\mu\text{m}$ 100–160 $\mu\text{m}$	100–220 $\mu\text{m}$ (on subst.) 80–154 $\mu\text{m}$ (on CMA)
width at base	5–6.5 $\mu\text{m}$	4.5–5 $\mu\text{m}$ 4–6 $\mu\text{m}$	4–8 $\mu\text{m}$ (on subst.) 4–6 $\mu\text{m}$ (on CMA)
width at apex	6–8 $\mu\text{m}$	up to 9 $\mu\text{m}$ 8–10 $\mu\text{m}$	7–9 $\mu\text{m}$ (on subst.) 7–8 $\mu\text{m}$ (on CMA)
<b>Conidia</b>			
length	32–(40)–48 $\mu\text{m}$	34–(40)–47 $\mu\text{m}$ 30–40 $\mu\text{m}$	37–(43.4)–48 $\mu\text{m}$ (on subst.) 26–(34.7)–41 $\mu\text{m}$ (on CMA)
width	9–(11)–12 $\mu\text{m}$	12–(13)–14 $\mu\text{m}$ 9–14 $\mu\text{m}$	11–(11.7)–13 $\mu\text{m}$ (on subst.) 10–(11.1)–15 $\mu\text{m}$ (on CMA)
<b>Cell length</b>			
end cell	2.7–4.5 $\mu\text{m}$	4–5.5 $\mu\text{m}$	4–6 $\mu\text{m}$ (on subst.) 4–6 $\mu\text{m}$ (on CMA)
penult. cell	6.3–9 $\mu\text{m}$	6.3–7.2 $\mu\text{m}$	7–9 $\mu\text{m}$ (on subst.) 6–7 $\mu\text{m}$ (on CMA)
median cell	6.3–8.1 $\mu\text{m}$	(7.2–) 9–12.6 $\mu\text{m}$	8–11 $\mu\text{m}$ (on subst.) 5–8 $\mu\text{m}$ (on CMA)
<b><i>Chalara</i> -form in culture</b>			
	unknown (absent?)	present	absent

<sup>1)</sup> From (8, 17).

<sup>2)</sup> For each item, the entry above is from (8) and that below is from (12).

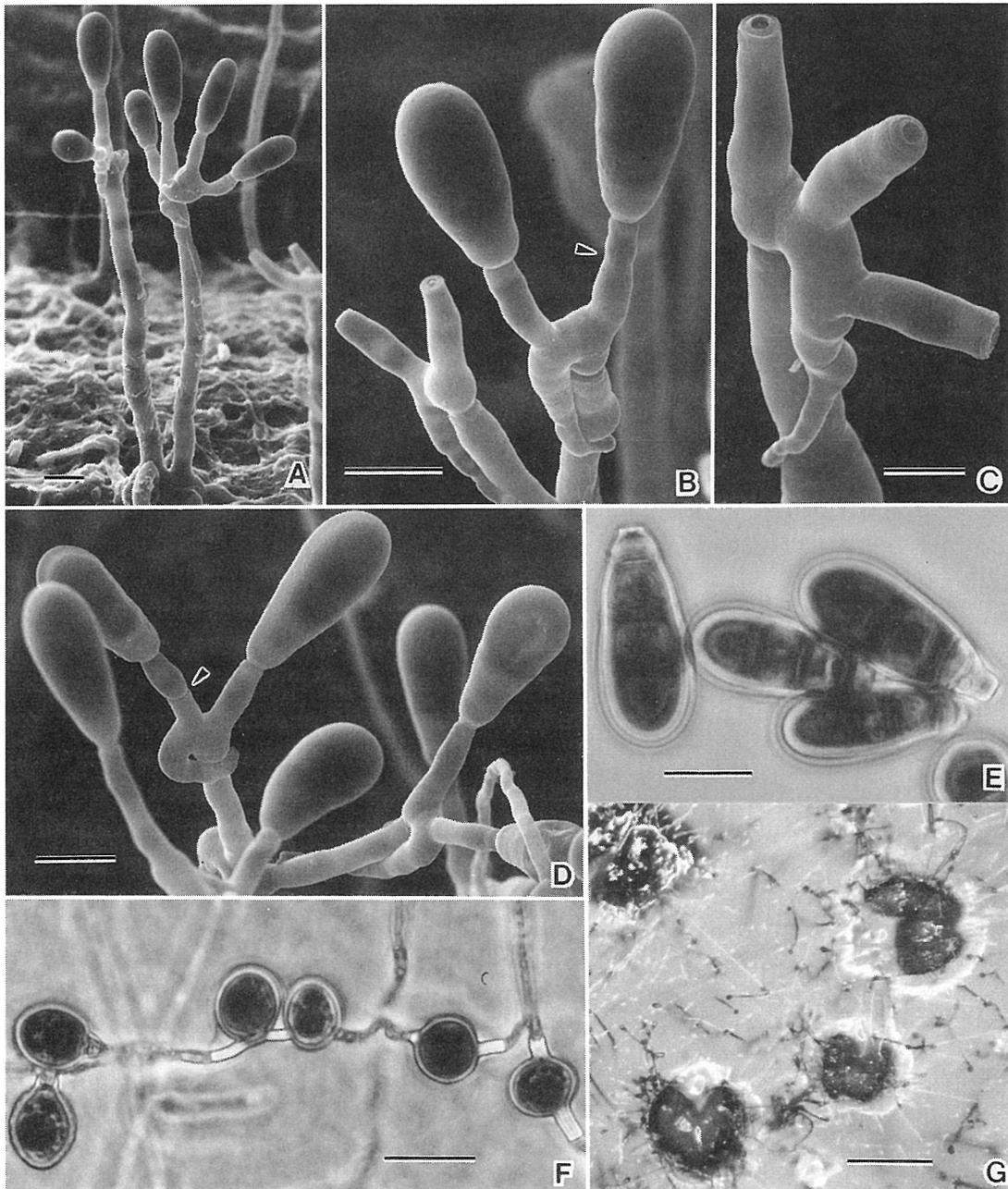


Fig. 1. *Brachysporiella arengae*. A-E. On substrate. F-G. On CMA. A. Conidiophores and conidia. B-D. Conidiophore apex showing successive conidium formation on peculiar branching system of conidiogenous cell. Arrowheads indicate percurrent proliferation of conidiogenous cell. E. conidia. F. Chlamyospores. G. Ascomatal intitial-like structures with conidiophores produced on CMA, exposing inside pseudoparenchyma. (Bars: A, B, D-F=10  $\mu$ m; C=5  $\mu$ m; G=200  $\mu$ m)

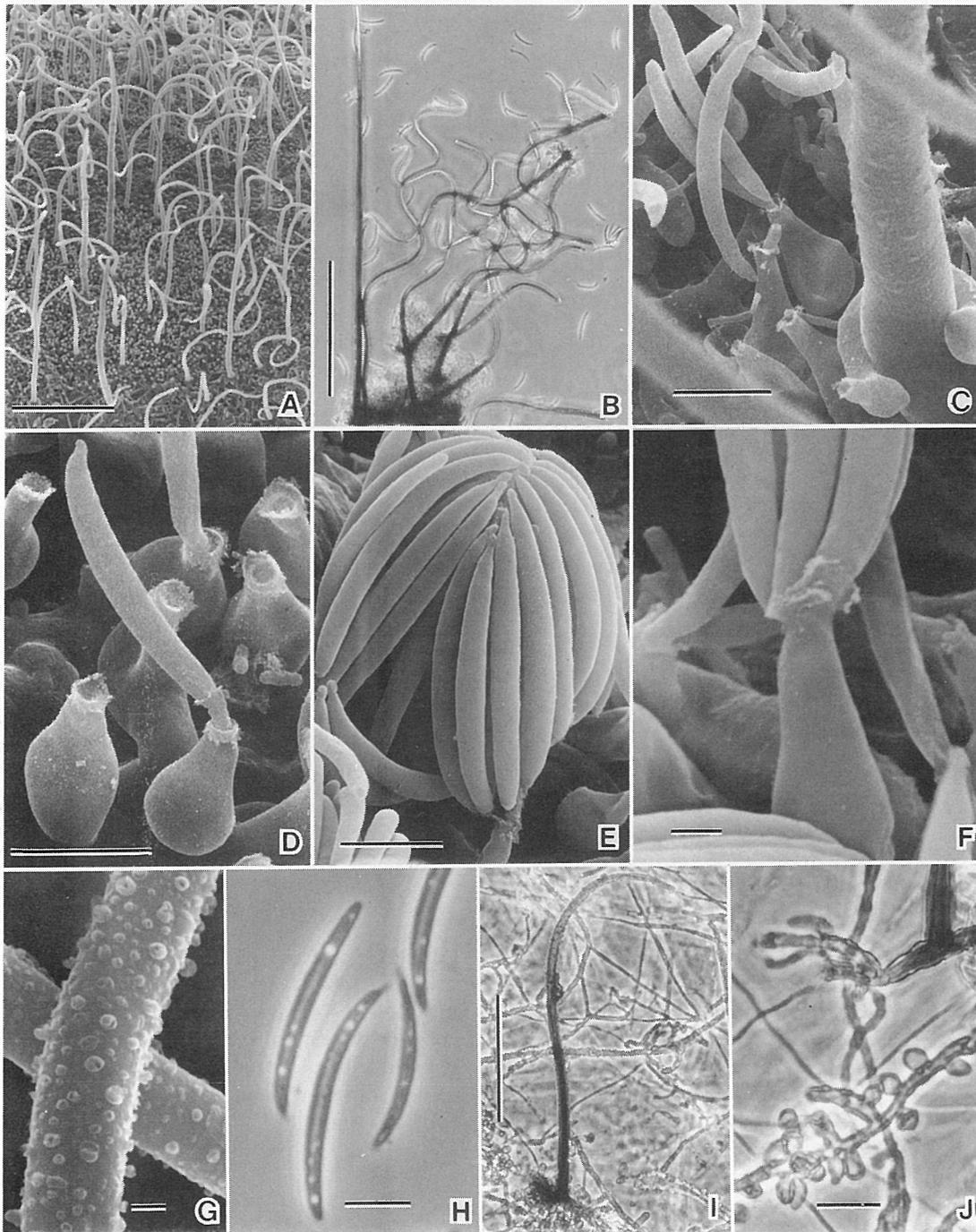


Fig. 2. *Circinotrichum falcatisporum*. A-H. On substrate. I-J. On CMA. A. Habit on a leaf, showing setae and phialides at the base. B. Straight and circinate setae. C-D. Phialides on repent hyphae, producing conidia. E-F. Conidia in mass on a phialide. Mucilage surrounds phialide apex and proximal end of conidial mass. G. Tuberculate seta. H. Conidia. I. Seta formed on CMA. J. Phialide-like projections on repent hyphae on CMA. (Bars: A, B=100  $\mu\text{m}$ ; C-E, H=5  $\mu\text{m}$ ; F, G=1  $\mu\text{m}$ ; I=50  $\mu\text{m}$ ; J=10  $\mu\text{m}$ )

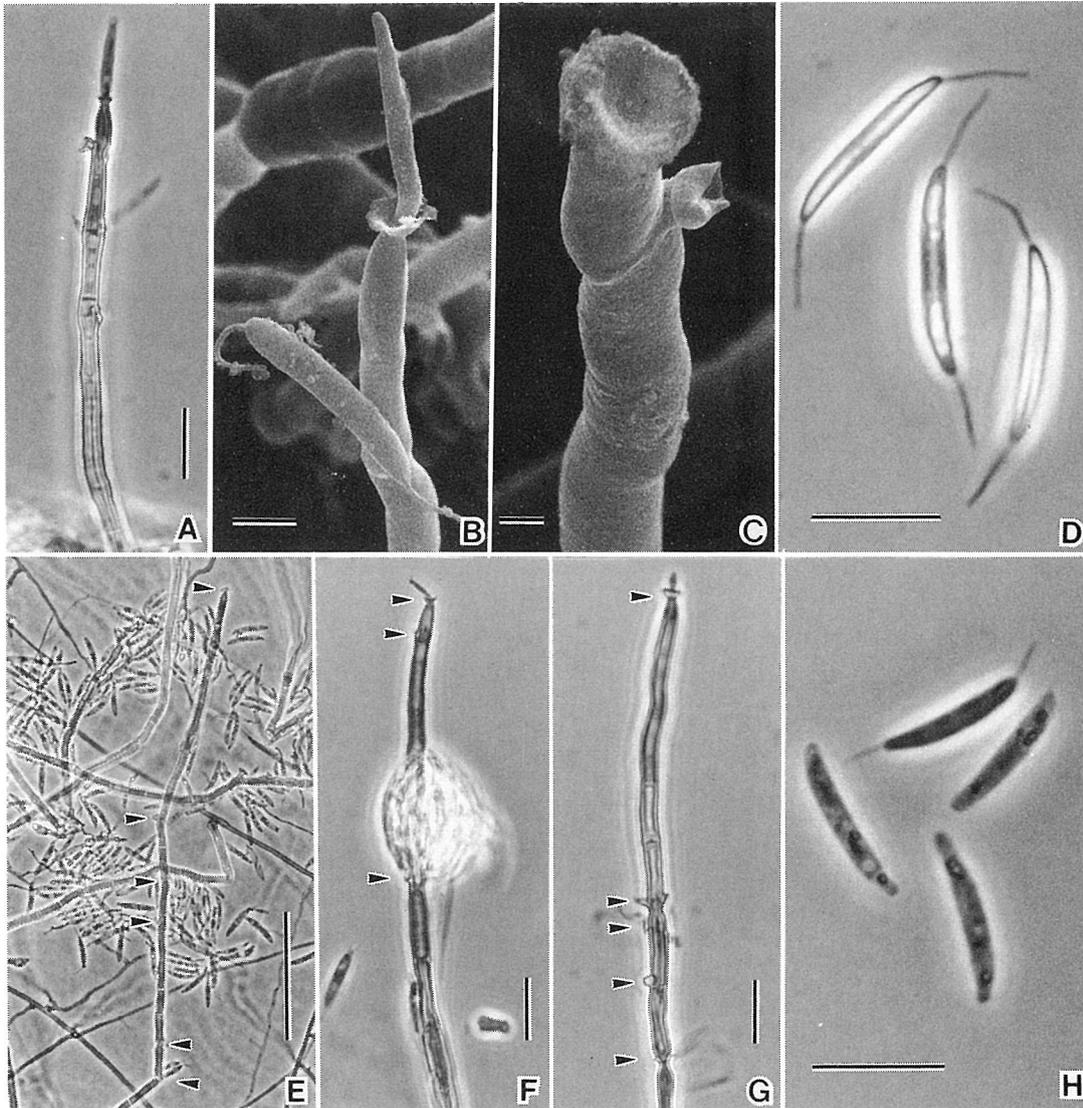


Fig. 3. *Codinaea simplex*. A-D. On substrate. E-H. On CMA. A. Conidiophore producing conidium at the apical phialide. B-C. Conidiophore apex with collarettes. D. Conidia with hair-like appendages at both ends. E-G. Conidiophores proliferating sympodially or percurrently on CMA. Arrowheads indicate collarettes. H. Conidia with or without appendages. (Bars: A, D, F-H = 10  $\mu$ m; B = 5  $\mu$ m; C = 1  $\mu$ m; E = 50  $\mu$ m)

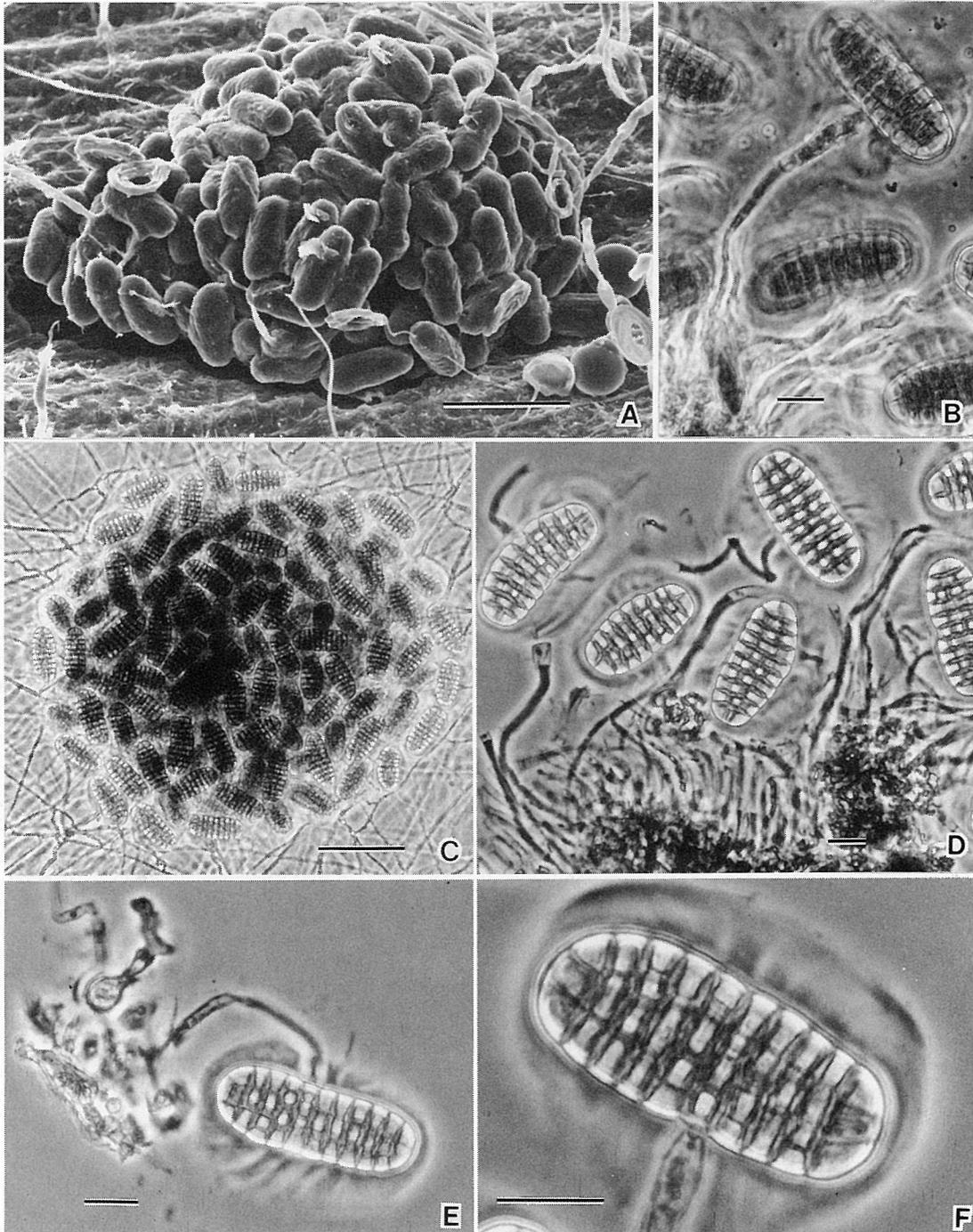


Fig. 4. *Coleodictyospora cubensis*. A-B. On substrate. C-F. On CMA. A. Sporodochium with a mass of conidia. B. Conidia and conidiophores. C. Mass of conidia in a sporodochium formed on CMA. D-E. Conidia and conidiophores extending from basal mat of sporodochium. F. Conidium with mucilaginous sheath. (Bars: A, C=50  $\mu\text{m}$ ; B, D-F=10  $\mu\text{m}$ )

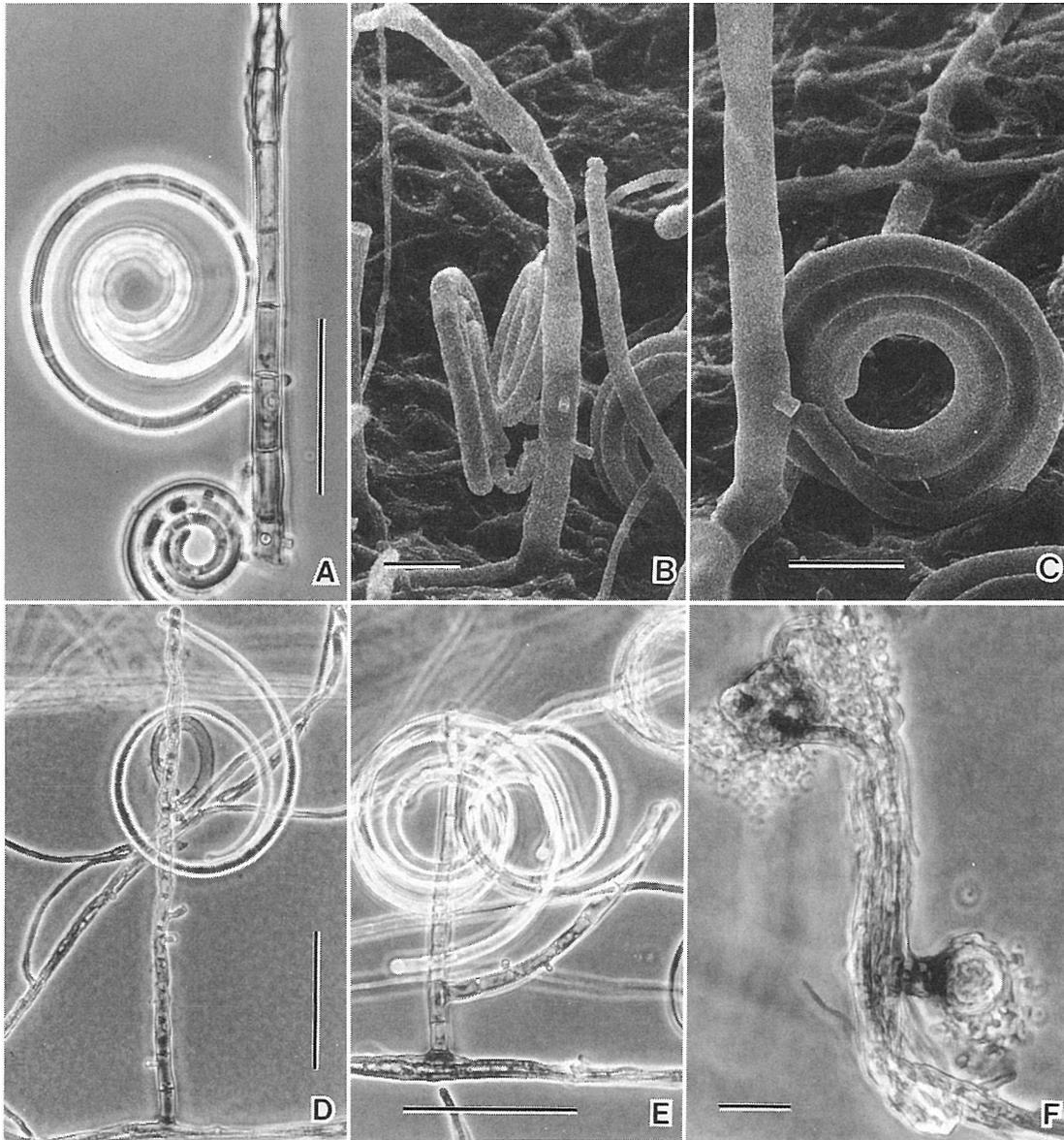


Fig. 5. *Drepanospora pannosa*. A-C. On substrate. D-F. On CMA. A-C. Erect conidiophore forming coiled conidia pleurogenously on teeth-shaped conidiogenous cells. D. Straight and simple conidiophore with a conidium. E. Branched conidiophore with conidia. F. Chlamydospore-like structures ('sclerote pedicelee') releasing small granules. (Bars: A, D, E = 50  $\mu\text{m}$ ; B, C, F = 10  $\mu\text{m}$ )

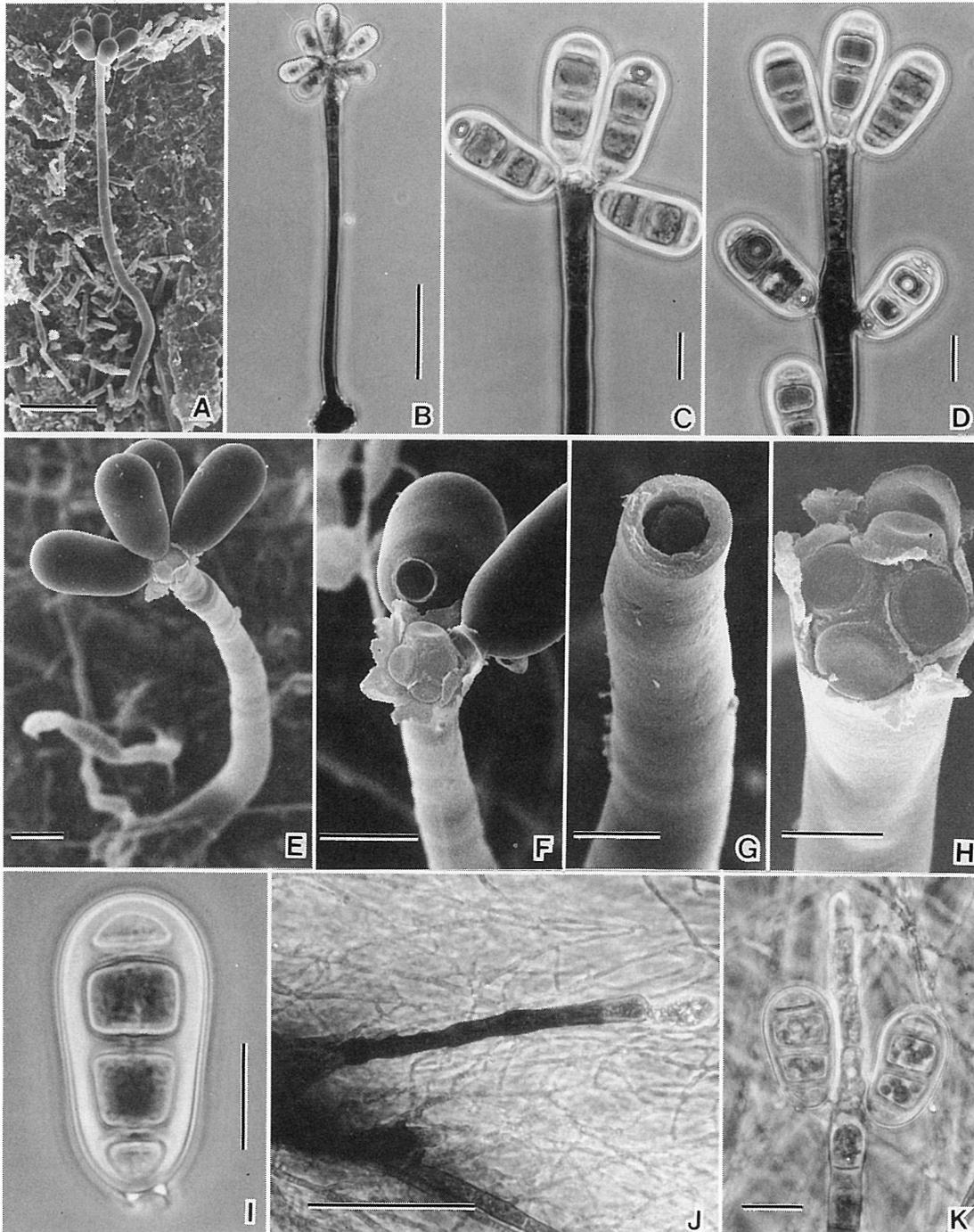


Fig. 6. *Exerticlava triseptata*. A-I. On substrate. J-K. On CMA. A-B. Conidiophore and conidia. C, E. Conidiophore apex with successively produced conidia. D. Percurrently proliferated conidiophore with conidia. F. Conidiophore apex with exposed conidiogenous cell showing disc-shaped scars of conidium detachment. G. Conidiophore apex after releasing the first conidium. H. Conidiophore apex with 4 or 5 conidium-detachment scars. I. Conidium. J. Conidiophore and conidium formed on CMA. K. Percurrently proliferated conidiogenous cell. (Bars: A, B, J = 50  $\mu\text{m}$ ; C-F, I, K = 10  $\mu\text{m}$ ; G, H = 5  $\mu\text{m}$ )

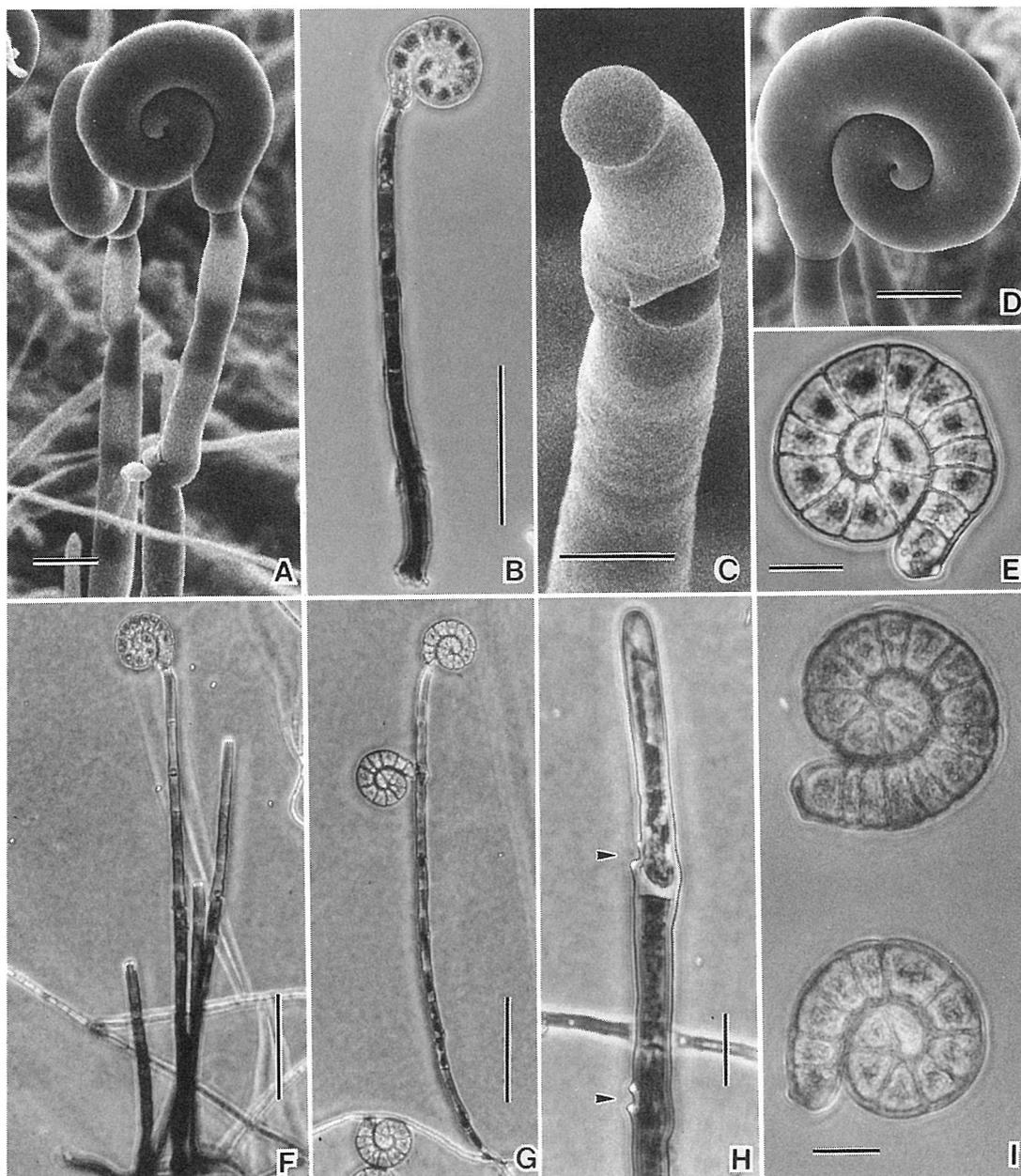


Fig. 7. *Helicoma palmigenum*. A-E. On substrate. F-I. On CMA. A-B. Conidiophores and conidia. C. Sympodially proliferated conidiophore bearing a semi-discoid scar of conidium detachment. D-E. Helicoid conidium. F-G. Conidiophores and conidia formed on CMA. H. Proliferating conidiophore with conidium detachment scars (arrowheads). I. Conidia. (Bars: A, D, E, H, I=10  $\mu$ m; B, F, G=50  $\mu$ m; C=5  $\mu$ m)

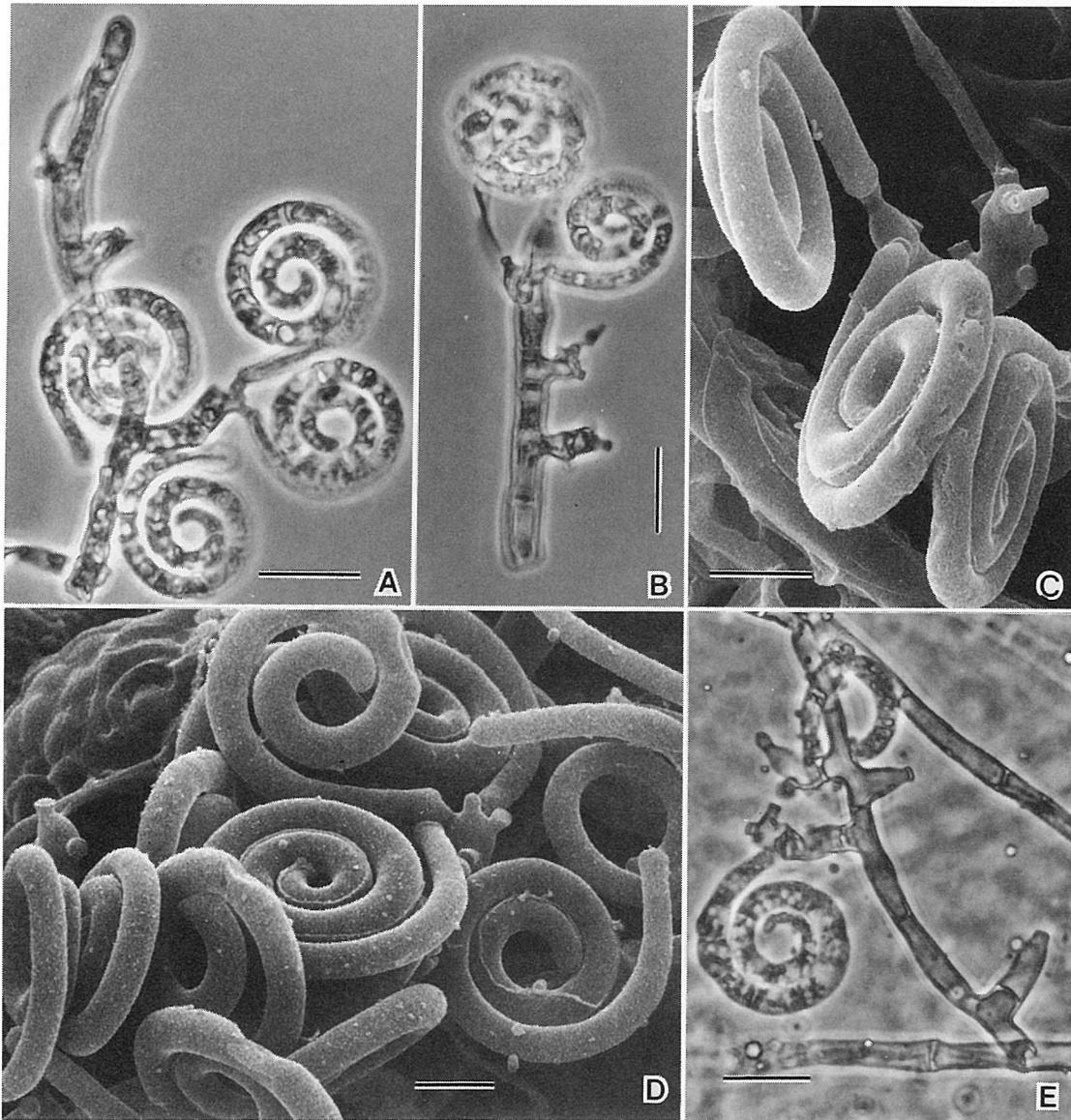


Fig. 8. *Helicomyces lilliputeus*. A-D. On substrate. E. On CMA. A. Erect and branched conidiophore with conidia. B-E. Coiled conidia formed on denticulate conidiogenous cell. (Bars: A, B, E=10  $\mu$ m; C, D=5  $\mu$ m)

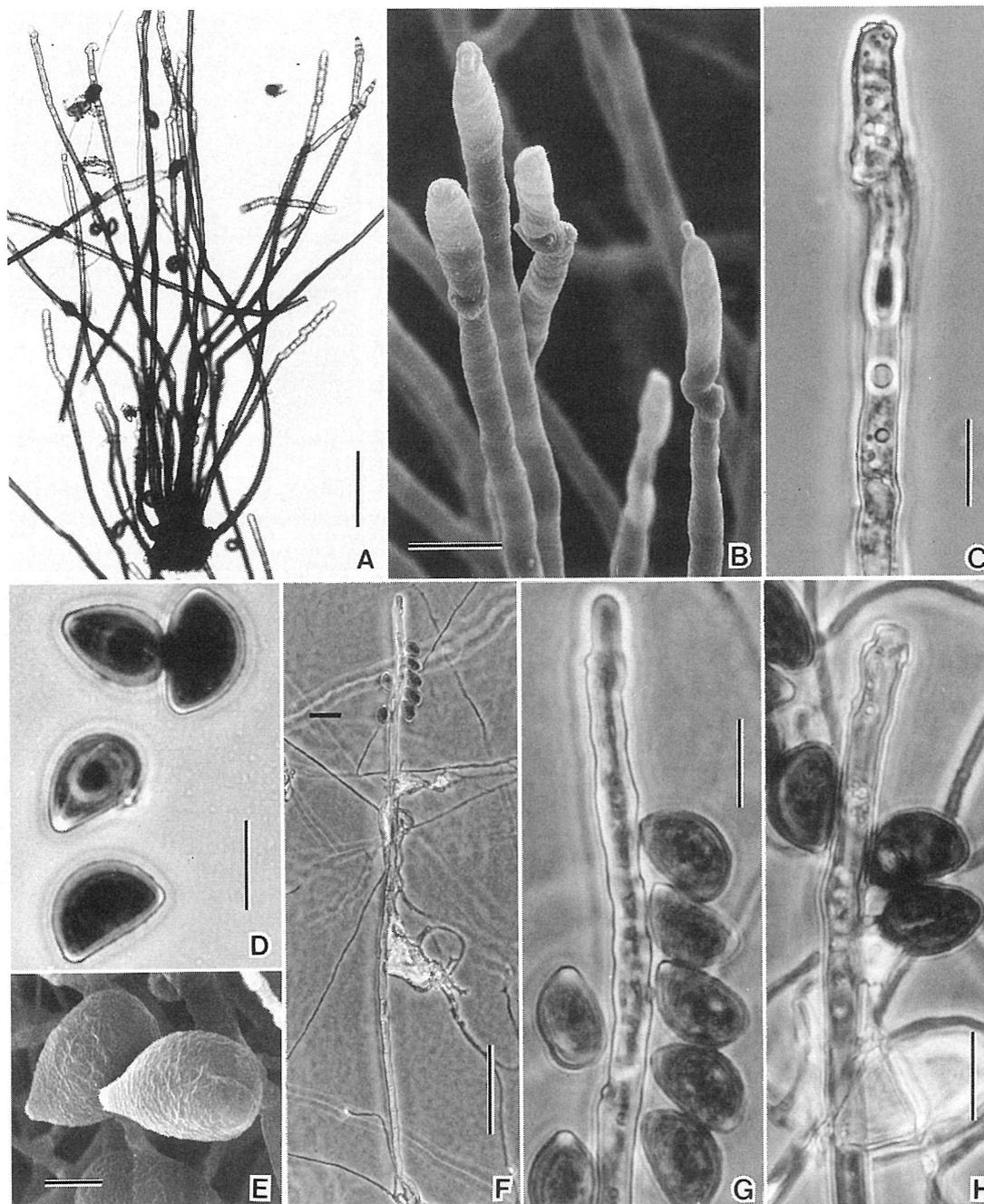


Fig. 9. *Melanographium citri*. A-E. On substrate. F-H. On CMA. A. Loose fascicles of conidiophores. B-C. Conidiophore apices showing sympodial proliferation. D-E. Conidia. A germ slit is seen on a dorsal side. F-H. Conidiophore and conidia formed on CMA. (Bars: A, F = 50  $\mu$ m; B-D, G, H = 10  $\mu$ m; E = 5  $\mu$ m)

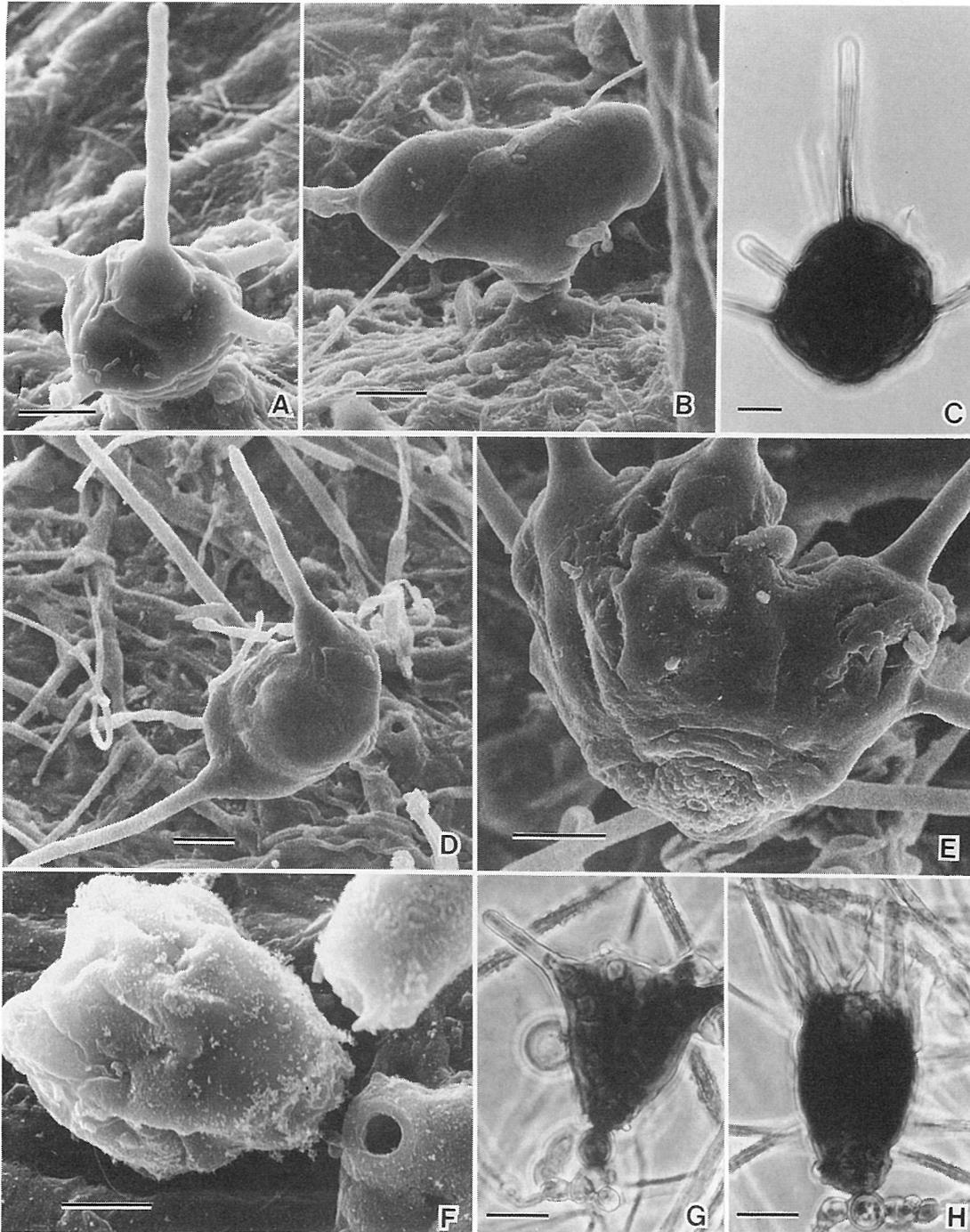


Fig. 10. *Piricauda cochiniensis*. A-F. On substrate. G-H. On CMA. A-B. Conidium formed on a short conidiogenous cell on repent hyphae. C. Conidium with filiform appendages. D, F. Conidium detaching from conidiogenous cell. A pore remains on the apex of conidiogenous cell. E. Proximal end view of conidium showing a pore surrounded by verrucae. G-H. Conidia produced on CMA. (Bars: A-E, G, H=10  $\mu$ m; F=5  $\mu$ m)

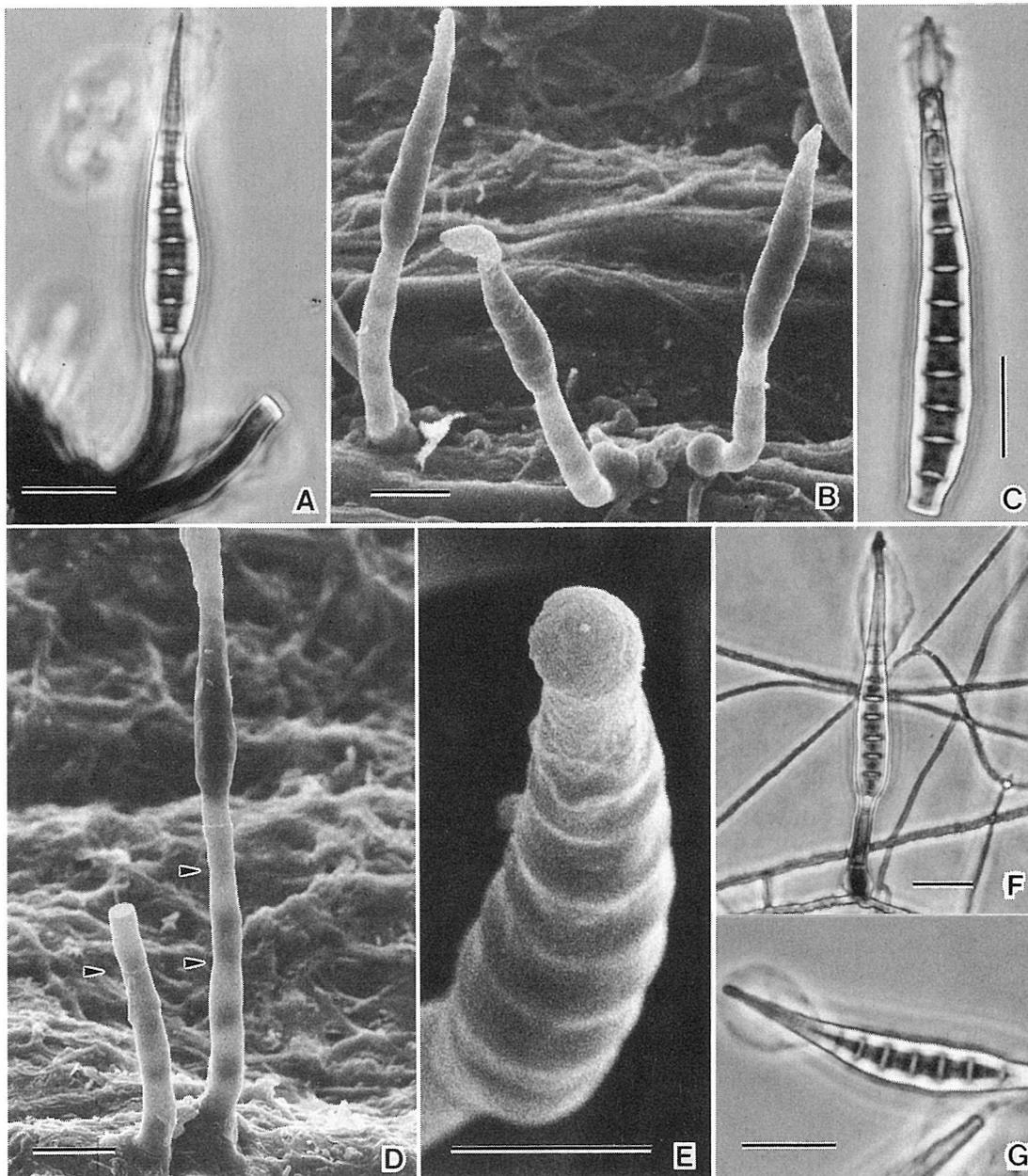


Fig. 11. *Sporidesmium minigelatinosum*. A-E. On substrate. F-G. On CMA. A-B. Erect conidiophores and conidia. C. Conidium with a mucilage at the apex. D. Proliferated conidiophores leaving scars (arrowheads) of conidium secession. E. Conidium apex with a mucilage. F-G. Conidia produced on CMA. (Bars: A-D, F, G=10  $\mu$ m; E=5  $\mu$ m)

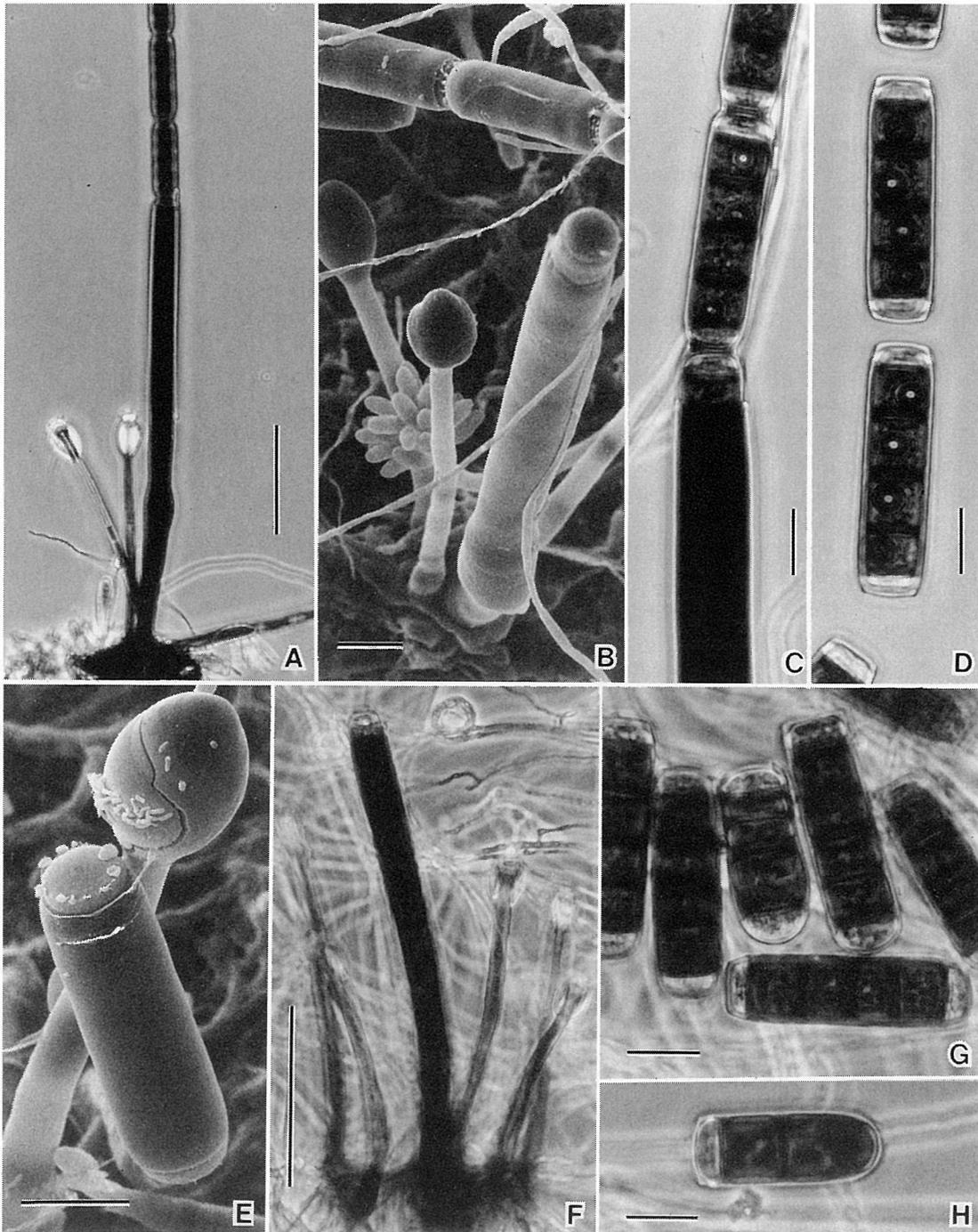


Fig. 12. *Sporoschisma saccardoi*. A-E. On substrate. F-H. On CMA. A-B. Conidiophore and capitulate hyphae. C. Conidia produced in chain from a phialide. D. Conidia. E. Capitulate hypha and conidium. F. Conidiophore and capitulate hyphae on CMA. G. Conidia. H. Bullet-shaped conidium formed firstly from a phialide. (Bars: A, F= 50  $\mu$ m; B-E, G, H= 10  $\mu$ m)

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