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The Merosporangiferous Fungi from Taiwan (I): Two New Records of *Syncephalis*

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ABSTRACT: During an investigation of Zygomycetes fungi in Taiwan, two merosporangiferous fungi, *Syncephalis obconica* and *S. sphaerica* belonging to the genus *Syncephalis*, Piptocephalidaceae (Zoopagales), were isolated from soil. Both species represent new records for Taiwan. The differences in morphological characters and hosts between these two species and closely related taxa are briefly discussed.

KEY WORDS: Merosporangiferous fungi, *Syncephalis*, Taiwan, Zygomycetes

INTRODUCTION

The genus *Syncephalis* was established in 1873 by van Tieghem and Le Monnier, and, to date, 49 species have been described (Benjamin, 1985; Gruhn and Petzold, 1991). The genus *Syncephalis*, along with the genus *Piptocephalis*, constitutes the Piptocephalidaceae family (Fitzpatrick, 1930) which has been included in the Mucorales (Benjamin, 1959; Hesseltine, 1955; Zycha *et al.*, 1969; Hesseltine and Ellis, 1973). Their sporangiospores are borne in cylindrically shaped merosporangia on branched or unbranched aerial sporangiophores. Zygospores are warty and borne on tong-like suspensors, which are often spirally wound with globose outgrowths (Hawksworth *et al.*, 1995). Kreisel (1969) transferred the Piptocephalidaceae to Zoopagales based on its similarity in mode of parasitism, vegetative development, and fruiting structure with Zoopagaceae, the predacious member of Zoopagales.

Species of *Syncephalis* van Tieghem & Le Monnier (1873) are common elements of soil and dung fungal biota. They are obligate parasites of other fungi, mainly the Mucorales species. *Syncephalis* species are small and inconspicuous, usually with simple sporangiophores arising from branched, short rhizoids. A terminal globoid or turbinate ampulla is formed by the sporophore, from which gives rise to small or large numbers of merosporangia, which have few to many spores. When mature, the merosporangia disarticulate and the head of spores are typically enveloped in a drop of liquid.

The merosporangia of *Syncephalis* may be unbranched, as in *S. sphaerica* and *S. cornu*, or branched, as in *S. obconica* and *S. cordata.* Van Tieghem and Le Monnier (1873) coined the name *Syncephalis* because they thought the small, deciduous, triangular bodies subtending the merosporangia of *S. cordata*, the type species of the genus, represented sterile head cells like those subtending the merosporangia of certain species of *Piptocephalis,* another member of the same family. Van Tieghem (1875) later recognized that these cells were actually the lowermost spores of branched merosporangia.

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Previously, two members of *Syncephalis* were reported from Taiwan by Dr. C.-Y. Chien. They were *S. cornu* van Tieghem & Le Monnier and *S. reflexa* van Tieghem (Chien, 1999). Recently *S. depressa* van Tieghem & Le Monnier was reported by the author from several places of Taiwan (Ho, 2000). These three species were all isolated from soil. To date, among the 49 species of *Syncephalis*, only three species were reported from Taiwan. The purpose of this paper is to describe two new records of *Syncephalis* from Taiwan. They were both isolated from Yangmingshan, Taipei, Taiwan. The differences in morphological characters and hosts between these species and closely related taxa are briefly discussed.

MATERIALS AND METHODS

Soil samples were collected from country roadsides or forests and brought to the laboratory in plastic bags. Two to three milligrams of soil particles were placed on corn meal agar plates. The plates were left on the bench at room temperature, incubated for ca. 1 week, then observed using a dissecting microscope. When the sporophores of *Syncephslis* were found, they were transferred by cutting a small block of agar with the sporophores and its host to a fresh corn meal agar plate. After one week, the regenerated, mature sporangia of *Syncephalis* were transferred with a sterilized needle to pre-marked spots in a new corn meal agar plate. One day after inoculation, the spores of mucoraceous host were inoculated beside the parasite. After 4-7 days, the colony of the host was found parasitized by the *Syncephalis* species.

SEM

Pertinent materials were selected under a dissecting microscope and fixed for 1 hr with 2.5% glutaraldehyde in distilled water, and post-fixed for 1 hr with 1% osmium tetraoxide in distilled water. The materials were washed with distilled water and dehydrated in a graded acetone series. Specimens were dried in a critical point dryer, coated with gold, observed, and photographed with a Hitachi S-520 scanning electron microscope (SEM) at 20 KV.

LM

Pertinent materials were selected under a dissecting microscope and mounted in water or lactophenol cotton blue. Photographs were taken with a Leica MPS32 light microscope (LM).

TAXONOMY

Syncephalis obconica Indoh, Sci. Rep.Tokyo, Kyoiku Univ. Sec. B, 11:17-18, 1962.

Vegetative mycelium thin, sometimes subterraneous. Merosporangiophore solitary or 1-3 in cluster, delicate, 118-193 μm heigh, 7-12 μm in diameter at the broadest part near the base, gradually attenuated upwards, colorless. Rhizoids stout, usually simple, short. Heads obconical, 7.5-11.3 μm in diameter, 7.5-11.3 μm heigh, bearing 11-33 merosporangia on the truncate top in a circle (Figs. 1A-C).

Merosporangia branched once at the base, forming two branches with a V-shape angle (Fig. 1C). These two branches were nearly equal in length, long, cylindrical, containing 5-6 spores, and connected to the head by a prominent projection which remained as a wart after the merosporangium detached (Fig. 1D). Merospores cylindrical, 4.5-6.0 x 2.5-2.6 μm (Fig. 1E).

Zygophoric structure not observed.
Parasitic on *Mucor* sp.
Material examined: S3P201, isolated from soil, Yangmingshan, Taipei.
Distribution: Japan (Indoh, 1962; Kuzuha, 1973).

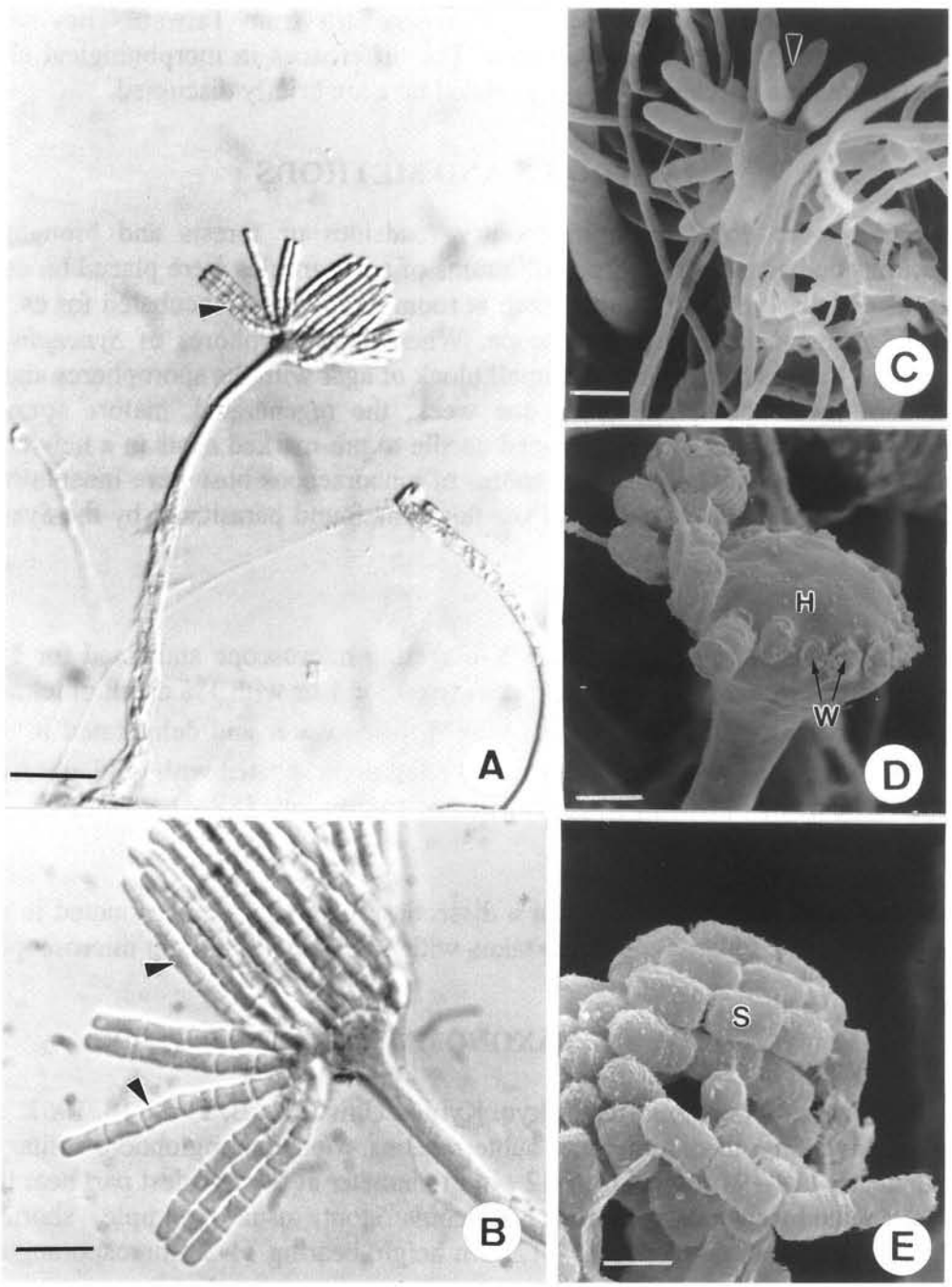

Fig. 1. *Syncephalis obconica*, A & B, LM (Normaski), C-E, SEM. A. Sporophore with head and merosporangia (Arrow head) on head. Bar = 20 μm. B. Enlargement of the head of sporophore shown in Fig. A. showing the articulated merosporangia articulating into merospores (arrow head). Bar = 10 μm. C. Bottom view of a head bearing dichotomously branched young merosporangia (Arrow head). Bar = 10 μm. D. Fertile head (H) with warts (W) left after merosporangia detached. Bar = 4 μm. E. Cylindrical merospores (S). Bar = 5 μm.

Note: This species was first isolated from forest soil in Japan and described as a new species by Indoh in 1962. According to Indoh, the merosporangia were arranged in a circle on top of the head and were unbranched. These two features were used by Indoh as important key characteristics. However, Indoh's student, Kuzuha (1973), stated that she observed Indoh's specimen with branched merosporangia in the course of her study. Almost all the merosporangia were branched, especially in well-developed individuals. She also mentioned that Dr. C.–Y. Chien also observed branching merosporangia during the survey of Japanese Mucorales (unpublished). The author notes the observed merosporangia of the Taiwan specimen were branched like Kuzuha's observation.

Two other species closely related to *S. obconica* are *S. depressa* van Tieghem & Le Monnier and *S. nodosa* van Tieghem. They both have merosporangia attached in a circle on the top of sporophores head, like that of *S. obconica*. The difference between *S. obconica* and *S. depressa* is the branching merosporangia of the latter differentiate into a horizontal basal cell and 2-5 upright cylindrical sporiferous branches. The differences between *S. obconica* and *S. nodosa* are the latter has noded merosporophores and merospores with remarkably wrinkled membranes.

Syncephalis sphaerica van Tieghem, Ann. Sci. Nat. 6 ser. 1:125, pl.3, figs. 105-109, 1875.

Vegetative hyphae arachnoid, 0.5 μm in diameter. Merosporangiophores erect, stand singly or 1-6 in cluster, 400-600 μm heigh, 12-22 μm broad at the base, tapering towards head, thinnest at the site below the head, 6-7 μm in diameter, very rarely septated. Rhizoids digitate, 3-6 μm long, separated from the merosporangiophore by a distinct basal septum. Heads oval to spherical, 27.5-44 μm in diameter, bearing merosporangia in a dense cluster on upper half of heads (Figs. 2A, B).

Merosporangia cylindrical, articulating into 3-6 merospores when mature, usually three (Figs. 2B, E). Conspicuous warts left on the upper surface of head after detachment of the merosporangia (Fig. 2C). Merospores stout, cylindrical, or rod shaped, 5-5.1 x 11-12.5 μm. Membrane derived from sporangial wall stout, remained on the surface of the spores, forming fringes on both ends of the spores (Fig. 2D). Remarkable refractive bodies appeared near both ends of the spores, pale yellow in mass (Fig. 2E). Zygospores not observed.

Material examined: SYMC0203, isolated from soil, Yangmingshan, Taipei.

Parasitic on *Gongronella butleri* (Mucoraceae).

Distribution: France (Van Tieghem, 1875); US (Thaxter, 1897; Christenberry, 1940); India (Mehrotra and Prasad, 1965); China (Ou, 1940); UK (Jefferies and Kirk, 1976); Japan (Indoh, 1962); Germany (Zycha,1935); Canada (Bisby *et al.*, 1929); Australia (McLennan and Ducker, 1954).

Note: This species is closely related to *S. tranzschelii* Naumov. The difference between these two species according to Naumov (Zycha *et al.*, 1969) was that the spore size of the latter was 11-14 μm. The isolated sample has larger spore size.

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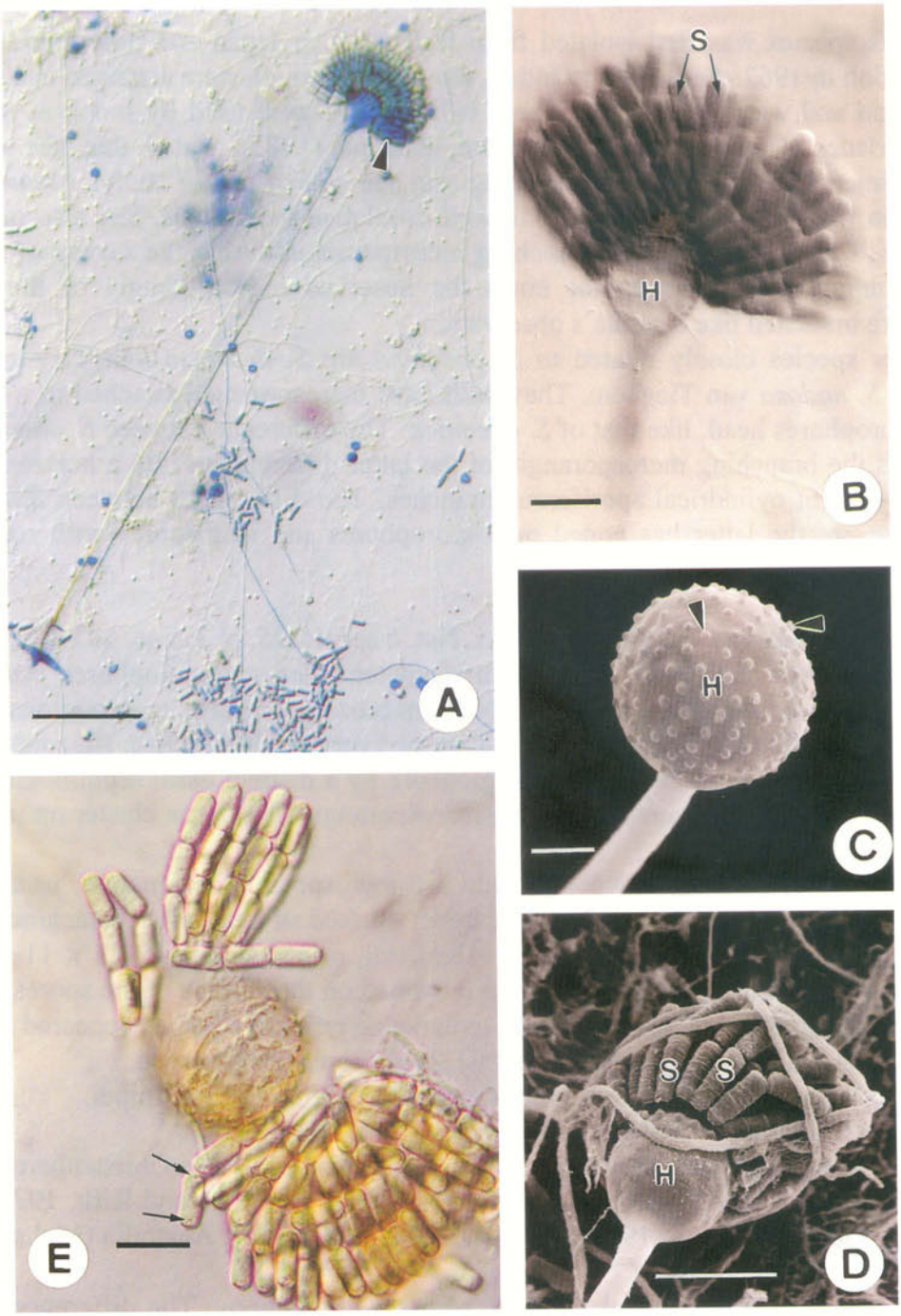

Fig. 2. *Syncephalis sphaerica*, A, B & E, LM (Normaski), C & D, SEM. A. Sporophore with head and merosporangia (arrow head) (stained with cotton blue). Bar = 50 μm. B. Fragmented merospores (S) on head (H). Bar = 20 μm. C. Fertile head (H) with warts (arrow heads) left after merosporangia detached. Bar = 15 μm. D. Fragmented merospores (S) on head (H). Bar = 38 μm. E. Mature and detached merosporangiospores, note the refractive bodies (arrows) on both ends of the spore. Bar = 20 μm.

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台灣管狀孢子囊接合菌之研究(I)：兩種集珠黴屬新紀錄種

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摘　　要

在一項台灣接合菌研究過程中，有兩種具管狀孢子囊的真菌 *Syncephalis obconica* 及 *S. sphaerica* 被分離並鑑定。兩者均為台灣的新紀錄。文中討論其與接近種類之異同，並報告其宿主種類。

關鍵詞：管狀孢子囊真菌、集珠黴屬、台灣、接合菌綱。

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