

## *Aspergillus taichungensis*, a new species from Taiwan

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*Aspergillus taichungensis* isolated from a soil sample collected in Taiwan is described as a new species. The new species is characterized by its restricted growth on Czapek's and malt extract agars and its white to light yellow colonies, radiate conidial heads, smooth and often diminutive conidiophores, hemispherical to elongate vesicles with biseriata aspergilla (conidiogenous cells), globose, micro-verrucose conidia and dark brown sclerotia. The species somewhat resembles *A. versicolor*, *A. terreus* and *A. flavipes*, but differs in cultural and morphological details, and is considered to represent an interface species in the subgenus *Nidulantes*.

Key Words—*Aspergillus taichungensis*; hyphomycete; soil fungus; Taiwan.

During the past decade, our screening for useful microbial products has focused on tropical fungi as a source of novel molecules. Undoubtedly, tropical habitats house the greatest diversity of microorganisms, so it can be expected that tropical fungi will tend to be more abundant and more species—diverse than those in other geographical regions. Taiwan's wide range of climate has resulted in an extremely broad distribution of microfungi, from temperate to tropical, in a small area (e.g., Matsushima, 1980, 1981, 1983, 1985, 1987).

From this country, 42 species of *Aspergillus* and related teleomorphs were recorded in the recent publication by Tzean et al. (1990). Since *Aspergillus* species have a preference for (sub)tropical zones (Christensen and Tuthill, 1985; Samson, 1994), their occurrence in Taiwanese soils could be expected. A representative of the species herein described was isolated from a soil sample collected in central Taiwan in the 1994 survey.

### Taxonomy

*Aspergillus taichungensis* Yaguchi, Someya et Udagawa, sp. nov. Fig. 1

Coloniae in agar Czapekii restrictae, plus minusve velutinae, planae, ex mycelio basali coacto tenuiter laxo constantes; conidiogenesis moderata, flavo-alba vel primulina; reversum incoloratum. Coloniae in agar "Czapek-yeast extract" (CYA) aliquantum celeriter crescentes, velutinae vel floccosae, ad centrum elevatae, plus minusve rugosae, ex mycelio basali coacto crassiusculo constantes; conidiogenesis abundans, dilute flava vel straminea; exsudatum parvum et hyalinum; reversum cum agar dilute flavum vel electrinum. Coloniae in agar maltoso restrictae, floccosae, aliquantum convolutae, ex mycelio basali coacto compacto constantes; sclerotia tarde formantia, atrobrunnea; conidiogenesis inconspicua, flavo-alba vel primulina; reversum dilute fla-

vum vel luteolum.

Capitula conidica alba vel dilute flava, laxe radiantia, usque 160  $\mu\text{m}$  diam. Conidiophora vulgo ex mycelio basali oriunda; stipites stricti vel sinuosi, vulgo 300–440  $\times$  5–9  $\mu\text{m}$ , hyalini vel dilute brunnei, incrassati, leves, superne non constricti; vesiculae hemisphaericae vel elongatae, 5–20  $\mu\text{m}$  diam, hyalinae, in 1/2–2/3 superficie fertiles. Aspergilla biseriata; metulae 5–13.5  $\times$  4–7  $\mu\text{m}$ ; phialides 6.5–9  $\times$  2.5–3  $\mu\text{m}$ . Conidia hyalina, in massa dilute flava, vulgo globosa vel subglobosa, 3–4  $\mu\text{m}$  diam, interdum ovoidea, 3–5  $\times$  3–4.5  $\mu\text{m}$ , fere levia (micro-verrucosa sub SEM), catenata. Sclerotia atrobrunnea, globosa vel ovoidea, 300–500  $\times$  200–400  $\mu\text{m}$  diam. Conidiophora deminuentia ex hyphis aeriis oriunda; stipites 90–250  $\times$  2–3  $\mu\text{m}$ , tenuis; aspergilla biseriata sed deminuta.

In agar Czapekii chlamydosporae abundanter formantes, terminales vel intercalares, hyalinae, globosae vel subglobosae, 6–8  $\mu\text{m}$  diam, incrassatae, leves.

Holotypus: PF1167; colonia exsiccata in cultura ex solo, Taichung, Taiwan, 20. x. 1994, a T. Yaguchi isolata et ea collectione fungorum Musei et Instituti Historiae Naturalis Chiba (CBM) conservata.

Etymology: Latinized from the name Taichung, referring to the city of the type locality.

Colonies on Czapek agar growing restrictedly, attaining a diameter of 12–15 mm in 7 days at 25°C, more or less velvety and loose-textured, plane, consisting of a thin basal felt, with thin margins; conidiogenesis moderate, Yellowish White (M. 2A2, after Kornerup and Wanscher, 1978) or Primrose (Rayner, 1970); exudate not produced; reverse uncolored. Sclerotia not observed.

Colonies on CYA growing more rapidly, about 18–20 mm in diam in 7 days at 25°C, velvety to floccose, centrally raised, more or less wrinkled, consisting of a fairly tough basal felt with abundant conidial heads, Light Yellow (M. 2A4) or Straw (R), with narrow margins;

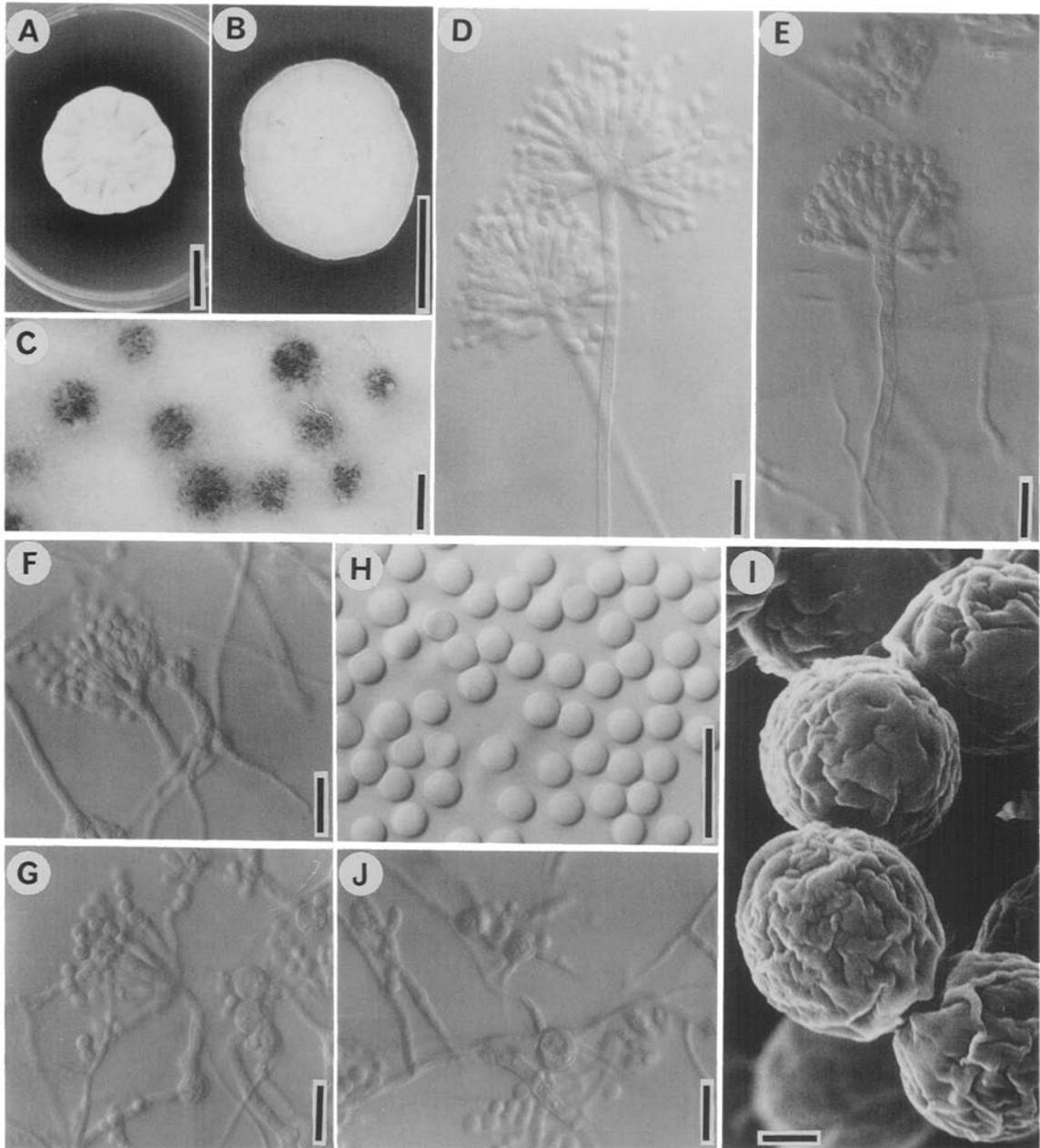


Fig. 1. *Aspergillus taichungensis*, MF 1167.

A. Colony on CYA, after 14 days at 25°C. B. Colony on MEA, after 30 days at 25°C. C. Sclerotia. D-G. Aspergilla, showing typical and diminutive ones. H. Conidia (LM). I. Conidia (SEM). J. Chlamydospores.

Scale bars: A, B = 2 cm, C = 500  $\mu$ m, D-H, J = 10  $\mu$ m, I = 1  $\mu$ m.

small, clear exudate formed; odor lacking or indefinite; reverse Light Yellow (M. 4A5) or Amber (R), with surrounding agar colored in the same shades. Sclerotia not observed.

Colonies on malt extract agar (MEA) growing restrictedly, attaining a diameter of 9-11 mm in 7 days at 25°C, floccose, somewhat convoluted, consisting of a tough basal felt with slow development of dark brown sclerotia within 28 days; conidiogenesis inconspicuous, Yellowish White (M. 3A2) or Primrose (R); margins abrupt; reverse Light Yellow (M. 4A4) or Pale Luteous

(R).

Colonies on MY20 agar 18-20 mm in diam in 7 days at 25°C, floccose, radially sulcate, centrally raised, consisting of a rather compact mycelial felt; conidiogenesis inconspicuous, Yellowish White (M. 3A3) or Primrose (R); exudate lacking; reverse Light Yellow (M. 4A5) or Amber (R). Sclerotia not observed.

Colonies on cornmeal agar growing restrictedly with vegetative mycelium submerged, producing limited conidial heads on the agar surface.

Conidial heads white to pale yellow, loosely radiate

Table 1. Comparison of diagnostic characteristics of some sections in the subgenus *Nidulantes* similar to *Aspergillus taichungensis*.

Characteristic	<i>A. taichungensis</i>	<i>Versicolores</i>	<i>Terrei</i>	<i>Flavipedes</i>
Conidial heads	radiate; white to pale yellow	radiate to loosely columnar; usually green to blue green	columnar; buff to orange-brown	radiate to loosely columnar; white to pale fawn
Conidiophores	moderate in length, hyaline to brown, smooth, often diminutive	moderate in length, hyaline to brown, smooth or rough, often diminutive	short, hyaline, smooth, not diminutive	moderate in length, hyaline to brown, smooth, sometimes diminutive
Vesicles	hemispherical to elongate; fertile over the upper 1/2-2/3	pyriform, clavate, spatulate or globose; fertile over at least the upper 1/2	hemispherical; fertile over the upper 1/2-2/3	subglobose to ovate or elongate; fertile over the upper 2/3
Aspergilla	biseriate	biseriate	biseriate	biseriate
Conidia*	mostly globose, micro- verrucose	usually globose, echinulate, lobate-reticulate, micro-verrucose, or micro-tuberculate	slightly ellipsoidal, striate	globose, smooth
Sclerotia	present, dark brown	sometimes present, pale colored	sometimes present, pseudosclerotial	absent
Hülle cells	absent	often present	absent	sometimes present

\*SEM data (except *A. taichungensis*) from Kozakiewicz (1989) and Tzean et al. (1990).

in pattern, up to 160  $\mu\text{m}$  in diam. Conidiophores usually arising from the basal mycelium; stipes straight or sinuous, mostly 300-440  $\times$  5-9  $\mu\text{m}$ , hyaline to pale brown, heavy walled, smooth, not constricted below the vesicles; vesicles hemispherical to elongate, 5-20  $\mu\text{m}$  in diam, hyaline, fertile over the upper half to two-thirds. Aspergilla biseriate; metulae variable in size, 5-13.5  $\times$  4-7  $\mu\text{m}$ ; phialides 6.5-9  $\times$  2.5-3  $\mu\text{m}$ . Conidia hyaline, pale yellow in mass, mostly globose to subglobose, 3-4  $\mu\text{m}$  in diam, sometimes ovoid, 3-5  $\times$  3-4.5  $\mu\text{m}$ , nearly smooth (micro-verrucose under the SEM, shown in Fig. 1-l), borne in chains. Sclerotia dark brown, globose to ovoid, 300-500  $\times$  200-400  $\mu\text{m}$  in diam. Diminutive conidiophores arising from aerial hyphae as side branches; stipes 90-250  $\times$  2-3  $\mu\text{m}$ , thin-walled; biseriate, conidia as described, vesicles and aspergilla somewhat reduced in size.

Chlamydospores abundantly produced on Czapek agar, terminal or intercalary, hyaline, globose to subglobose, 6-8  $\mu\text{m}$  in diam, thick-walled, smooth.

Growth on CYA at 37°C is slower than at 25°C, attaining a diameter of 15 mm in 7 days.

Specimen examined: PF1167(holotype), a dried culture of an isolate from soil, Taichung city, Taiwan, 20 October 1994, coll. T. Yaguchi. The holotype has been deposited with the Natural History Museum and Institute, Chiba (CBM), Japan.

The outstanding features of *A. taichungensis* are: (1) restricted growth on Czapek's agar and MEA at 25°C, (2) white to light yellow color of its radiate conidial heads, (3) brownish, smooth-walled conidiophores with hemispherical to elongate vesicles, (4) biseriate aspergilla (conidiogenous cells) with metulae and phialides covering the upper half to two-thirds of the vesicle, (5) nearly globose, micro-verrucose conidia, and (6) dark brown sclerotia. The secondary production of diminutive conidiophores is also characteristic of *A. taichungensis*.

The general characteristics of *A. taichungensis* are suggestive of the subgenus *Nidulantes* W. Gams et al. in *Aspergillus* (Raper and Fennell, 1965; Samson, 1979; Gams et al., 1985; Klich and Pitt, 1988), particularly the species in three sections (*Versicolores*, *Terrei* and *Flavipedes*) of that subgenus. However, the proper placement of *A. taichungensis* remains in doubt, as shown in Table 1. Within these sections, *A. taichungensis* somewhat resembles *A. flavipes* (Bain. et Sart.) Thom et Church, which has white to pale buff, radiate conidial heads, hyaline to light brown conidiophores with a small vesicle, globose, smooth-walled conidia, and the production of diminutive aspergilla. The combination of features including relatively short conidiophores (mostly 500-800  $\mu\text{m}$  long in *A. flavipes*), micro-verrucose conidia (completely smooth-walled in *A. flavipes*), and the production of dark brown sclerotia indicates that *A. taichungensis* represents a new interface species in the subgenus *Nidulantes*. Ascostromata have been observed only in occasional strains of *A. flavipes*, and these were placed in the teleomorphic genus *Fennellia* (Wiley and Simmons, 1973; Yaguchi et al., 1994). Ascomata mature inside the stromatic hyphal masses within 50-60 days, the wall consisting of several layers of yellow, thin-walled, hyphal cells. They differ strikingly from the sclerotia of *A. taichungensis*, in which no evidence of a teleomorphic state has been seen.

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