

Foliicolous Ascomycetes 8: Vietnam¹

DON R. REYNOLDS

Natural History Museum of Los Angeles County
900 Exposition Boulevard, Los Angeles, California 90007, USA

Abstract

Records for Vietnam foliicolous ascomycetes (including the mitosporic species) are reviewed. The current locations of previously cited specimens are noted. Recent collections from Ba Vi and Cuc Phuong National Parks are annotated in the genera *Appendiculella*, *Asteridiella*, *Asterina*, *Atractilina*, *Hyalosphaeria*, *Leprieurina*, *Malacaria*, *Meliolaster*, *Polychaeton*, *Sarcinella*, *Sirosporium* and *Trichothyrium*. Seven of the twelve species are new records.

Introduction

Distinct lineages of foliicolous ascomycetes have evolved to live on plant surfaces. They are distinguished by adaptive morphological attributes and nutritional modes. These species constitute a guild found in close association with vascular plants. The hypothesis underlying this report and related work is that the diversity and distribution of this mycota reflects overall biodiversity patterns of the associated flora.

The historical record for foliicolous fungi is rich in Southeast Asia. The overall mycota of the Philippines and Indonesia is particularly well known from mycological efforts beginning in the latter part of the 1800s. Firsthand knowledge of foliicolous ascomycete fungi from field work over a 35-year period by the author in Myanmar, Malaysia, the Philippines, Singapore, Thailand as well as Taiwan and mainland China, has sustained an impression of distinctive biodiversity patterns. Likewise, the historical records from Vietnam suggest a distinct assemblage of foliicolous species.

An Overview of Vietnam Mycology

An inventory of Vietnamese fungi based on the literature comprises 365 species and 5 varieties in 143 genera. Vietnam type localities were cited for 46 species and 1 variety. A comparison of the Vietnam mycota with records from the Philippines up to about 1905 (Teodoro, 1937) indicates a 45% similarity.

¹Continued from: Reynolds, D.R. 1986. Foliicolous Ascomycetes 7: A teleomorphic phylogeny of the Capnodiaceae. *Mycotaxo*. 27: 377–403.

The mycota of Vietnam was initially made known from collections of J. B. Balansa and P. Bon and various others associated with a French Scientific Mission in "Tonkin" and "Annan" at the turn-of-the century. These collections were examined and published by Hennings (1895), von Höhnelt (1918), Karsten and Roumeguère (1890), Patouillard (1889, 1890, 1891, 1892, 1893, 1896, 1897, 1907, 1909), and Roumeguère (1886a, 1886b, 1890, 1892). Studies of mitosporic ascomycete fungi associated with plant diseases were made by F. Bugnicourt (Mouchacca, 1997). Bùi Xuân Dong (1972, 1977, 1986) proposed a revision of Hyphomycete classification as a doctoral thesis and subsequently undertook a survey of Vietnamese Hyphomycetes, especially species of *Aspergillus* and *Penicillium* (Bùi Xuân Dong and Hoang Xuan Vinh, 1977).

The locations of surviving specimens from Vietnam and adjacent areas have been difficult to ascertain because of the destruction and relocations that have occurred related to destructive world events in this century and a subsequent lack of citation in recent literature. The difficulty of obtaining specimen information is compounded by a dearth of accessible fungal data, especially for type specimens. The alternative has been the compilation of specimen information through personal visits to the major herbaria of the world. These data are incorporated into this report.

Field Survey of Cuc Phuong and Ba Vi National Parks

The intent of recent collection efforts in Vietnam, the basis of this report, was to resample the foliicolous mycota in order to gain better insight into regional fungal biodiversity. This report is based on collections made in December 1996 from the Cuc Phuong and Ba Vi National Parks in northern Vietnam that have been designated as areas of high diversity worthy of conservation (Khanh, 1994). Collections were made by the author accompanied by Dr. Tran Ninh, Hanoi National University and Dr. Benito Ching Tan, National University of Singapore.

One set of specimens is deposited in the University of Hanoi (HNU), a second set in the Natural History Museum of Los Angeles County (LAM). Specimens examined in this study are cited here after the species description. For herbaria, the acronyms follow those in *Index Herbariorum* (Holmgren *et al.*, 1990). Specimens mentioned in historical reports are located in B, FH (Pfister, 1977 for Patouillard's type specimens), FLS, P, and S.

The collection sites

The World Wide Fund for Nature characterizes Vietnam as one of Asia's most biologically important countries (Anon., 1996). Ba Vi and Cuc Phuong

are two national parks cited by Khanh (1994) as major forest reserves of Vietnam.

The vegetation of Cuc Phoung and Ba Vi National Parks was described by Schmid (1989) and Nguyen Van Truong (1966) as Thaiindian monsoon forests. The 25,000-ha Cuc Phuong National Park is located about 100 km south of Hanoi in Ninh Binh, Hoa Binh and Thanh Hoa provinces, 20° 19'N, 105° 22'E. It comprises lowland and sub-montane seasonal evergreen sub-tropical forest with lowland rain forest in the flatter parts of the broad valley formed between two limestone ranges with elevations from 150–637 m. The park flora is estimated at 2,000 flowering plant species.

The 2,140-ha nature preserve portion of Ba Vi National Park is located about 50 km west of Hanoi in Ha Tay Province, 21° 25'N 105° 30'E. The three closed, moist forest types in this region are evergreen tropical, evergreen sub-tropical, and broad-leaved and coniferous evergreen sub-tropical forests. An “elfin forest” favouring the growth of bryophytes is found in the high humidity, higher elevations of the sub-tropical areas. The elevation in the park ranges from the lower boundary of the nature preserve at 400 m to 1,270 m on Dihn Vua peak.

The sampling technique for foliicolous fungi utilized in this study and the one apparent in the historical record is the haphazard, non-random method that I call a “visual survey.” Collections were made by taking leaves at ground level and within arm’s reach up to about 2.5 m that were visibly colonized by fungi until there was an intuitive sense of diminished return in a localized area.

Annotation of Recently Collected Foliicolous Species

1. *Appendiculella* Höhn., Stizb. K. Akad. Wiss. Wien, Math.-naturw. Kl. 128 (1919) 556.

Ascocarp darkly pigmented, globose, with larviform appendages; ascus globose, thin-walled; ascospores darkly pigmented, 4-septate; mycelium darkly pigmented, superficial on living plant surfaces, hyphopodiate; without setae.

Appendiculella arecibensis (F. L. Stevens) Toro, Mycologia 17 (1925) 144.

Ascocarp 194–213 µm diam.; 4–8 erect larviform appendages brownish, continuous, 113 x 26 µm at base; ascospore ellipsoid, 4-septate, 44–48 x 20 µm.

Illustration: Hansford, 1963: Pl. LXX.

Specimen examined: Cuc Phoung National Park, Park Center, Don R. Reynolds V325, 19 December 1996 (LAM).

This is a new record for Vietnam. The ascocarp and the setae are larger and the ascospores are slightly smaller than those of the type specimen from Puerto Rico, as well as other collections from Central America.

The other species reported from Vietnam, *Appendiculella tonkinensis* (Karsten and Roumeguère) Toro, Mycologia 19 (1927) 71, was based on *Meliola tonkensis* Karsten and Roumeguère, Rev. Mycol. 12 (1890) 77 described from *B. Balansa* 5944 (P) Thu Phap, distributed in Roumeguère Fungi selecti exsiccati.

2. *Asteridiella* McAlpine, Proc. Linn. Soc. N.S.W. (1897) 38.

Ascocarp darkly pigmented, globose, glabrous; ascus globose, thin-walled; ascospores darkly pigmented, 4-septate; mycelium superficial on living plant surfaces, hyphopodate, without setae.

Asteridiella boni (Gaillard) Hansf.. Sydowia 10 (1962) 47.

Ascocarp to 230 µm diam. with conoid surface cells measuring up to 20 µm high; ascospore ellipsoid, 3-septate, 60 x 20 µm.

Illustration: Hansford, 1963: Pl. CCLXXXI.

Specimen examined: Ba Vi National Park, 1000 m. elevation, Don R. Reynolds V301, 22 December 1996 (LAM).

The type specimen of *A. boni* differs from the other four species known from Vietnam largely in the size of the ascospore, which measures 60 x 20 µm and is most similar in morphological attributes to that known only from a single Philippine collection.

Five species of *Asteridiella* are known from Vietnam. *Asteridiella boni* (= *Meliola boni* Gail., Le Genre *Meliola* (1892) 39), was based on *Bon* 3319 (P) from Tonkin. *Asteridiella duportii* Hansf., Beih. Sydowia Ann. Mycol., Ser. II. Beih. II. (1961) 239 was based on *Duport* 2 (FH) from ChoGauh. The type specimen for *A. gymnosporiae* (Sydow) Hansf., Sydowia 10 (1957) 48, is *PBS* 7422 from the Philippines; this species is also known from *Bon* 5191 (FH) from Thinh Hoa Phu Dien (initially determined as *Meliola laevis* Berk. and Curtis, J. Linn. Soc. London X (1869) 280). The type specimen *Balansa* 25 of *Asteridiella reticulata* (Kars. & Roum.) Hansf., Sydowia 10 (1957) 50, was collected in Tu Phap and determined as *Meliola reticulata* Kars. & Roum., Rev. Mycol. 12 (1890) 78. *Asteridiella verrucosa*

(Pat.) Hansf., Sydowia 10 (1957) 51 is based on *Meliola verrucosa* Pat., J. Bot. Paris 11 (1897) 347, (= *Irenina verrucosa* (Pat.) F. L. Stevens, Ann., Mycol. 25 (1927) 457, with *Bon* 5840 (FH 7719) as its type collected from Dinh Hoa; *Bon* 5851 was cited as an additional specimen in the original description.

3. *Asterina* Lév, Ann. Sci. Nat. Bot. sér. III. (1845) 59.

Ascospore two-celled, dark brown; ascus ellipsoidal, with thickened apex; paraphyses filamentous; ascocarp dark brown, initially forming a shield of radiate tissue over hymenium, becoming rounded, the upper portion breaking away with release of ascospores; mycelium darkly pigmented, hyphodiate.

Asterina melatomatis Lév., Ann. Sci. Nat. Bot. sér. III. (1845) 59.

Ascospores 25 x 13 µm; asci 40–50 x 24–30 µm; paraphyses hyaline, multicellular, 35 µm; ascocarp up to 320 µm diam.

Illustration: Müller & Arx, 1962: Fig. 31.

Specimen examined: Cuc Phoung National Park, Park Center, *Don R. Reynolds* VV339, 19 December 1996.

The material of this new Vietnam record is similar to *A. melatomatis* Lév., Ann. Sci. Nat. Bot. ser III. 3 (1845) 59, described from Brazil, but with ascocarps that measure 150 µm diam. The smaller ascospore size distinguishes *A. melatomatis* from previously reported Vietnam species.

Karsten and Roumeguère (1890) described several species of *Asterina* based on B. Balansa's Tonkin collections including *A. balanseana* Kars. & Roum., Rev. Mycol. 12 (1890) 76, from Hanoi, *A. insignis* Kars. & Roum., Rev. Mycol. 12 (1890) 77, from Tu Phap, *A. pauper* Kars. & Roum., Rev. Mycol. 12 (1890) 77, from Tonkin, *A. setulosa* Pat., J. Bot. 4 (1890) 62, and *A. sphaerotheca* Kars. & Roum., Rev. Mycol. 12 (1890) 76, from Dong Dong.

4. *Atractilina* Dearness & Bartholomew. Mycologia 16 (1924) 175.

Mitospores colourless to pale brown, fusiform, septate, with hilum, produced from polyblastic, sympodial, denticles; mitosporophores brown pigmented, erect, synemata forming; mycelium superficial, with pale brown pigmentation.

Atractilina parasitica (Winter) Deigh. & Piroz., Mycol. Papers 128 (1972) 34.

Mitospores ovoid to clavate to lanceolate, roughened, 30–80 μm x 3.5–9 μm , terminal end narrowing into a small terminal swelling; fruit body to 550 μm in height.

Illustration: Deigh. & Piroz., 1972: Fig. 17–19.

Specimens examined: Cuc Phoung National Park, Park Center, *Don R. Reynolds* V309, V517, V328, V332, V337, V339, 19 December 1996; Cuc Phoung National Park, trail from Park Center, *Don R. Reynolds* V342, 19 December 1996. Ba Vi National Park, 800 m elevation, *Don R. Reynolds* V366, V374, V375, 21 December 1996 (LAM).

This new record for Vietnam is widely known from the tropics as a parasite on species of *Amazonia*, *Asteridiella*, *Balladyna*, *Irenopsis* and *Meliola* and is recognized by its pale brown mycelium, which forms directly over the superficial mycelium. The species is also known from Babuyan, Puerto Princessance, Palawan, Philippines (*G. E. Edaño PNH 20531* and *IMI 76854b*).

5. *Hyalosphaeria* F. L. Stevens, Trans. Ill. Acad. Sci. 10 (1917) 172.

Ascospores fusiform, clavate or cylindric, hyaline to pale cinnamon, multiseptate; ascus fissitunicate, clavate; pseudoparaphysis present or absent; ascocarp white, luteous or brick, not changing colour in KOH, subglobose to discoid.

Hyalosphaeria miconiae F. L. Stevens, Trans. Ill. Acad. Sci. 10 (1917) 172.

Ascospore narrowly clavate to cylindric, ends rounded, 3-trans-septate, 36–57 x 4–5 μm ; ascocarps 100–140 μm diam.; non-ostiolate but open at maturity.

Illustrations: Pirozynski, 1977: Fig 4, A-C. Rossman, 1987: Fig. 34.

Specimen examined: Cu Phoung National Park, Park Center, *Don R. Reynolds* V326, 19 December 1996 (LAM).

The type specimen of *H. miconiae* is *F. L. Stevens* 207 (ILL) from Puerto Rico. The Vietnam collection is similar in most aspects to *H. miconiae* except that the ascospores are smaller and have sublate rather than rounded ends. Pseudoparaphyses are present as illustrated by Pirozynski (1977). The ascocarps measure 81 μm in length. The *H. miconiae* hyphae are surrounded and perhaps parasitized by hyphopodate and darkly pigmented hyphae. The identity of the hyphae as belonging to a *Meliola* sp. is suggested by the typical 4-trans-septate spores sans ascocarp present in the immediately close mycelial mat.

6. *Leprieurina* Arnaud, Ann. l'Ecole nat. d'Agric. Montpellier. 16 (1918) 210.

Mitospores 2-celled, brown, pyriform; conidiophores short, lining upper conidial centrum wall; pycnidium shield-shaped; mycelium brown, without hyphopodia.

Leprieurina winteriana Arnaud, Ann. l'Ecole nat. d'Agric. Montpellier 16 (1918) 211.

Mitospores, granulate, with apical cell 70% larger than the second cell, 26 x 17 μm ; pycnidium 1–3 mm.

Illustration: Arnaud, 1918: Pl. 47.

Specimen examined: Cuc Phoung National Park, trail from Park Center, Don R. Reynolds V341, 19 December 1996 (LAM).

This species is a new Vietnam record. Arnaud (1918) based his new species on *A. Puttemans* 149 (P), Brazil S. Paulensis. He indicated that *Prillieuxina winteriana* (Paschke) Arnaud, Ann. l'Ecole nat. d'Agric. Montpellier 16 (1918) 211 is the associated ascospore state but this was not observed in the recent Vietnam collections.

7. *Malacaria* H. Sydow, Ann. Mycol. 28 (1930) 69.

Ascospores clavate, fusiform or cylindric, multiseptate, pale grey; ascus fissitunicate; pseudoparaphyses unbranched, septate; ascocarp superficial with a thin stroma, dark luteous to brick red, unchanged in KOH, walls smooth or with hairs.

Malacaria meliolicola H. Sydow, Ann. Mycol. 28 (1930) 69.

Ascospores narrowly clavate with elongate basal end that are bluntly rounded, 3-septate, pale grey, 40–48 x 3–5 μm ; ascus clavate, 44–56 x 10–2 μm , pseudoparaphyses unbranched, up to 120 μm ; ascocarp 150–200 x 100–140 μm in diam..

Illustration: Rossman, 1987: Fig. 4.

Specimen examined: Ba Vi National Park, 1000 m elevation, Don R. Reynolds V520, 22 December 1996 (LAM).

The ascospore lengths of this new record for Vietnam fall within the 40–48 μm range described by Rossman (1987), but have a less tapering basal cell.

The ascospores of *M. luxurians* (Rehm) Rossman Mycological Papers. 157 (1987) 12, based on *Paranectria luxurians* Rehm, Leaf. Phil. Botany 8 (1916) 2924, found on *C. F. Baker*, *Fungi Malayana* 171 from the Philippines, measure up to 175 μm . Those of the Hansford type from Uganda measure 80–95 x 3–4 μm including a “30–45 x 1 μm basal appendage” (Hansford, 1961).

8. *Meliolaster* Höhn., Berich. Deut. Bot. Gesell. Berlin 35 (1918) 700.

Ascospores 3-celled, dark brown, fusiform; asci obpyriform, thickened at apex; asci globose, apically thickened, paraphyses present; ascocarp a dark brown thyriothecium, upper layer of radiate hyphae, opening with breaks originating in a stellate pattern from ascocarp centre; mycelium of darkly pigmented, hyphopodate.

There was some confusion concerning the name for this genus. Arnaud (1917) used the name *Patouillardina* for a new, monotypic genus. Bresadola (Rick, 1906) previously utilized *Patouillardina* for a name based on a basidiomycete (Bresadola, 1925; Donk, 1958; Martin, 1939; Rogers, 1936). Stevens (1927) regarded *Meliolaster* described by Doidge (1920) as a synonym of *Amazonia* Theissen, Ann. Mycol. 11 (1913) 499.

Meliolaster clavispora (Patouillard) Höhn., Berich. Deut. Bot. Gesell. Berlin 35 (1918) 700.

Ascospores 40–50 x 10–16 μm ; ascus 60–100 x 44–80 μm , paraphyses hyaline; ascocarp 200 μm in diam.

Illustrations: Arnaud, 1918: Pl. 37; Patouillard, 1890: Fig. 4.

Specimen examined: Cuc Phoung National Park, trail from Park Center, Don R. Reynolds V348, 19 December 1996 (LAM).

This species was first described as *Meliola clavispora* Pat., J. Bot. 4 (1890) 61, with the type specimen collected at Tu-Phap (P). It was later renamed as *Patouillardina clavispora* (Pat.) Arnaud, Comp. Rend. Acad. Sci. Paris 164 (1917) 181. A Balansa specimen at P, issued in the exiccatum set “Campignon du Tonkin 1887–1889”, is identified as the type. Both Arnaud (1917, 1918) and von Höhnelt (1918) critically examined this species based on an isotype specimen that was issued as *Roumeguère Fungi, selecti exsiccati* 5631. Both authors found the fungus to be microthyriaceaeous. Patouillard (1890) remarked: “Espèce bien distincte de toutes les congénères [*Dimerosporium*] par ses spores à deux cloisons”. Von Höhnelt (1918) noted: “Der Pilz ist ein *Dimerosporium* Fuckel mit drizelligen Sporen...”

9. *Polychaeton* (Persoon) Lév., Dict. Univ. d'Hist.Nat. 8 (1847) 454.

Fruit body comprised of an upright stalk formed of coalesced hyphae; a mitosporic centrum is formed along its length; mitosporophores phialidic; mitospores hyaline and unicellular.

Polychaeton citri (Per.) O. Kunze. 1891: 13.

Mitospores hyaline, aseptate, smooth, ovoid, 5–6 μm ; mitosporogenous centrum in somewhat basal to midregion of column, 58 x 32 μm ; stalk may extend to 31 μm above the centrum, and below 289–6 μm , almost becoming sessile on the substratum.

Illustrations: Batista & Ciferri, 1962b: Figs 4, 5, Figs. II: 8, V: 26, 28; VI: 31; VII: 35, 38; VIII: 43; X: 58; XI: 62; XII: 64; XIII: 71, 72; XIV: 78; XXI: 111, 112, 113; XXII.

Specimen examined: Ba Vi National Park, 800 m elevation, Don R. Reynolds V338, 21 December 1996 (LAM).

This species is similar to *Capnodium bambusae* Roum., Rev. Bot. 12 (1890) 160. The type specimen was collected from Hai Phong in December 1889, and distributed as *C. Roumeguère Fungi exsiccati precipue Gallici. Centurie LV. 5436*.

10. *Sarcinella* Sacc.. Michelia 2 (1880) 31.

Mitospores solitary, subspherical, dark brown, smooth, 4-celled and muriform, flattened; mycelium hyphodiate.

Sarcinella raimundoi Sacc., Ann. Mycol. 12 (1914) 313.

Mitospores dictyosporus as a 6–8 cell packet, 33–35 μm diam., darkly pigmented; mycelium darkly pigmented.

Specimens examined: Ba Vi National Park, park headquarters, Don R. Reynolds V315, 19 December 1996; Ba Vi National Park, Don R. Reynolds V356, 22 December 1966 (LAM).

This new record for Vietnam was originally described from *M.B. Raymundo-Baker 2016* (AM, NY and BPI) from Morong Valley in Rizal Province, Philippines. The species was distributed as a *C. F. Baker Fungi Malayana 192*, from Mt. Maquiling near Los Baños, Laguna Province, Philippines,

The Saccardo diagnosis included mention of fusoid, curved, 3-septate

mitospores characteristic of *Questieriella* Hughes, Can. J. Bot. 61 (1983) 1729. Hughes (1953, 1987) cited *Questieriella* as a "synapomorph" of *S. raimundii*. The predicted pleomorphy of *Schiffnerula* Höhn. Sitz. Akad. Wiss. Wien. Math. Naturwiss. Kl. Abt. 1, 118 (1909) 868 with *Sarcinella* (Hughes, 1983) has not been established with *S. raimundoi*.

11. ***Sirosporium*** Bubák and Sereb. apud Bubák, Hedwigia 52 (1912) 272.

Mitospores solitary, cylindrical, brownish, smooth to verrucose, with transverse and often longitudinal septa; conidiophores clustered, producing conidia from apex and laterally, branched or unbranched; mycelium partly immersed.

Sirosporium carissas Kapoor, Trans. Brit. Mycol. Soc. 51 (1968) 330.

The small fascicles of conidiophores produce brown, multiseptate mitospores from conspicuous scars; mitospores obclavate, mostly trans-septate with an occasional longiseptum, measuring up to 200 x 10 µm.

Illustration: Ellis, 1976: Fig. 226.

Specimen cited: Cuc Phoung National Park, trail from Park Center, Don R. Reynolds V353, 19 December 1996 (LAM).

This new record from Vietnam was originally described from India.

12. ***Trichothyrium*** Speg., Bol. Acad. Cienc. Córdoba 11 (1889) 555.

Ascospore clavate, hyaline, 1-septate, with upper cell smaller than the attenuated lower one; ascus obclavate with thickened wall, paraphysate; ascocarp a thyriothecium, a darkly pigmented, orbicular, ostiolate shield; mycelium comprised of septate, brown pigmented hyphae, most often forming a plate that widely covers the hyphae and hyphodia of the Meliolineae.

Trichothyrium reptans (Berk. & Curtis) Hughes, Mycol. Papers 50 (1953) 85.

Ascospore 15–20 x 5–7 µm; ascus obpyriform, 30–40 x 11–16 µm, with apically thickened wall; paraphyses hyaline 18 µm; ascocarp up to 160 µm in diam.; mitospore termed an isthmospore, rounded to oblong in surface view, 12–15 x 11–14 µm; mycelial plate up to 75 µm wide.

Illustration: Hughes, 1953: Figs. 48, 49.

Specimens examined: Cuc Phuong National Park, primary forest, Don R.

Reynolds V534, V300, V536, 17 December 1996; Cuc Phoung National Park, trail from Park Center, *Don R. Reynolds V318, V342*, 19 December 1996; Cu Phoung National Park. Research Station Building, *Don R. Reynolds V034, V334*, 20 December 1996.

This species and its mitospore were discussed in detail by Hughes (1953). The fungus is known from herbarium collections at IMI from Malaya and the Philippines and from the literature from the neotropics and Africa (Hughes, 1953). The isthmospores (= *Isthmospora glabra* Stevens, Bot. Gaz. 45 (1918) 224) in this new record for Vietnam differ from those reported from neotropical collections. The two pairs of pale brown cell components of these complex mitospores are thick-walled, but each pair possesses more than two upwardly and outwardly directed, rounded horns that are irregularly scattered over their surface.

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