Taxonomic consideration and Ecological Characteristics of Xylariaceae

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The Xylariaceae Tul. & C. Tul is a family of sphaeriaceous genera with obscure but apparently common ancestry (Rogers, 1979). A central core of genera - *Xylaria, Hypoxylon, Rosellinia, Poronia, Podosordaria, Hypocopra, Daldinia, Biscogniauxia, Kretzschmaria, Camillea, Penzigia* - are obviously related, regardless of the fact that the generic limits are arguable (Rogers, 1979; Barr, 1990; Eriksson & Hawksworth, 1991; Laessoe, 1994). In general, the family Xylariaceae is primarily defined as a group of stromatic pyrenomycetes with unitunicate asci characterized by a typical apical apparatus and pigmented ascospores having a germ slit (Rogers, 1979). Since Winter (1887) circumscribed the family to include Pyrenomycetes with predominately a dark stroma, dark unveiled spores containing 5 genera: *Nummularia* Tul. & C. Tul., *Hypoxylon* Bull., *Ustulina* Tul. & C.Tul., *Poronia* Willd. and *Xylaria*Hill ex Schrank, many more genera has been added to the family (Dennis, 1961; Eriksson & Hawksworth, 1993; Whalley, 1996). In the absence of a clear circumscription of the family (Rogers, 1994) the agreed number of accepted genera is governed by individual views and there are therefore difference between the proposals for the ascomycetes recognized 35 genera and indicated a further 3 which might belong there. Laessoe reviewed the family and included 37 genera but a few of these were listed as uncertain (Laessoe, 1994). In the most recent accounts Whalley (1996) listed 41 genera but again a number of these were considered uncertain and Ju and Rogers (1996) accepted 39 genera in their interpretation of the family. Since Laessoe (1994) merged *Daldinia* and *Versiomyces* with *Hypoxylon*and Ju and Rogers (1996) combined *Astrocystis* with *Rosellinia* and *Helicogermslita,* which can be argued strongly against, it is likely that a realistic number of genera will be close to 40 (Whalley, 1996; Table 1).

Morphology of the teleomorph

The classification of the xylariaceous fungi is regarded as artificial, as it is based on gross morphological characters such as size, color, and texture of the stroma, and the shape and color of the ascospores (Rogers, 1979; Whalley & Edwards, 1995). Stromatal characters have been the primary criteria for delimiting genera and species of the Xylariaceae. Stroma, often with ectostromatal development, may be brightly pigmented or black externally, internally white to dark, and occasionally gelatinous. Two basic types of ostioles can be recognized: the umblicate ostiolum characterized as a navel like depression in the stroma, and the papillate ostiolum, characteristically raised above the stroma surface, and recognized as a small nipple-shaped elevation on the stromatal surface. The kinds of ostiolum with the stromatal type are an important taxonomic character (van der Gucht, 1994). Perithecia areusually described as globose, ovoid, obovoid to tubular, they may be completely immersed, partially immersed or almost free. However, according to Rogers(1985), it is possible that there are taxonomically relevant, but yet unrevealed, developmental differences among several members of the Xylariaceae. Two basic types of ostioles can be recognized. The umbilicate ostiolum is characterized as a small depression in the stroma giving the appearance of small holes in the stromatal surface. The umbilicate ostiolum is typical for members of the genus *Hypoxylon* sect. *Hypoxylon* and some other genera. The papillate ostiolum on the hand projects above the stromatal surface and appears as a small nipple-shaped elevation. It is characteristic for members of the genera *Nemania* and *Rosellinia*.

Micromorphology

The paraphyses of Xylariaceae are all morphologically similar. They are simple and filiform, tapered, with an obtuse apex, thin walled and hyaline, remotely septate. They are generally persistent but appear to be more conspicuous in certain genera such as *Camillea*. The asci of most xylariaceous fungi are usually eight-spored, unitunicate, cylindrical and terminated below in a short or long stipe. The ratio of the sore bearing part to the stipe is sometimes taxonomically useful. The shape is often generically linked and can be considered to be very important in the taxonomy of the Xylariaceae. The ascospores of the Xylariaceae are usually described as single celled, with a smooth brown wall with a conspicuous and often full-length germ slit (Rogers, 1979). There are however a number of variations on this basic theme and in certain genera they are of considerable taxonomic significance. In general the ascospores are uniseriate or obliquely uniseriate. In shape most spores are subglobose, ellipsoid, oblong, fusiform, inequilaterally ellipsoid, broadly crescentric, with ends either narrowly or broadly rounded, attenuated or apiculate, Subglobose, ellipsoid, oblong or fusiform ascospores are usually found in the genera *Biscogniauxia* and *Camillea*whilst inequilateral ellipsoid spores acre characteristic for the genera *Daldinia* and *Hypoxylon* s. str. Broadly crescentric spores are usual for species of *Kretzschmaria* and *Xylaria* (Thienhirun, 1997). And their conspicuous hyaline outlet layer, appendages, spore dimensions and germ slit situation are useful information for taxonomy.

Morphology of the Anamorph

Most anamorphs of xylariaceous fungi are characterized by conidia which are formed holoblastically, are often pigmented, and have a broad, circular, flat totruncate base. The anamorphs can develop on the external surface of immature or maturing teleomorphic stromata, or in more or less close association with them. *Geniculosporium*-like anamorph, *Xylocadium*-like anamorph, *Xylocoremium flabelliforme* and *Acanthodochium*-like anamorph (Rogers, 1979; van der Gucht, 1994, Whalley, 1996) (Table 2).

Ecology

The Xylariaceae are mainly colleted on dead wood of angiosperms with relatively few occurring on gymnosperms. Their occurrence on dead wood and on plant remains in dung and soil reflects their mainly saprophytic nature (Rogers, 1979; Whalley, 1996). However, a number of species are parasites and a few species may be symbiotic or endophytic (Rogers, 1979). Climate, especially temperature, is an important factor affecting the distribution of many well-known fungi and the xylariaceous fungi and the xylariaceous fungi influenced not only at the habitat level but also on a global scale (Whalley, 1985). Although some members of the family are restrictedto major climatic zones, few studies have been undertaken to investigate their temperature requirements with respect to geographical distribution, Whalley (1985, 1996) noted that the Xylariaceae are common as endophytes and can occur on a wide range of untypical hosts sometimes on the side of their reported teleomorphic range (Table 2 and 3).

Host and substrate consideration

Many Xylariaceae can colonize a wide range of substrata. Whalley (1985) stated that in relation to distribution of some species the nutritional status of the host was probably not significant. For example, *Hypoxylon rubiginosum* Per.:Fr. Is truly cosmopolitan, not restricted by thermal zones, and occurs on a remarkably wide range of trees, *H. serpens* has been found in most countriesgrowing on many kinds of hardwoods, especially on old logs or stumps, while *H. atropunctatum* has been only found on Fagus in North America. Certain species colonize not only highly specific substratabut also under very exacting conditions. According to Whalley (1976) and Whalley and Walting (1980), *H. udum*, for example, a native of the British Isles and Europe is only found on *Quercus* and apparently only on decorticated wood that is highly rotten and usually water-sodden (Table 2).

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Table 1. Genera of Xylariaceae

Eriksson & Hawksworth (1993)	Laessoe (1994)	Whalley (1996)
Anthostomella Sacc.	*Anthostomella*	*Anthostomella* .
Ascotricha Berk.		Ascotricha
?*Ascotrichella* Valldos. & Guarro		?Ascotrichella
?*Astrocystis* Berk. & Broome	*Astrocystis*	*Astrocystis*
Biscogniauxia Kuntze	*Biscogniauxia*	*Biscogniauxia*
Calceomyces Udagawa & S.Ueda	*Calceomyces*	*Calceomyces*
Camillea Fr.	*Camillea*	*Camillea*
	Chaenocarpus Fr.	
	Collodiscula I. Hino & Katum.	
	Creosphaeria Theiss.	
Daldinia Ces. & De Not.		*Daldinia*
Engleromyces Henn.	*Engleromyces*	*Engleromyces*
Entonaema A. Moller	*Entonaema*	*Entonaema*
	Euepixylon Fuisting	*?Euepixylon*
Fassia Dennis		
Helicogermslita Lodha & D. Hawksw.	*Helicogermslita*	*Helicogermslita*
	Holttumia Lloyd	*?Holttumia*
Hypocopra (Fr.) J. Kickx f.	*Hypocopra*	*Hypocopra*
Hypoxylon Bull	*Hypoxylon*	*Hypoxylon*
Induratia Samuels, E. Mull. & Petrini	*Induratia*	*Induratia*
Kretzschmaria Fr.	*Kretzschmaria*	*Kretzschmaria*
Leprieuria Laessoe, J.D. Rogers & Whalley	*Leprieuria*	*Leprieuria*
Lopadostoma (Nitschke) Traverso	*Lopadostoma*	*Lopadostoma*
	?Myconeesia Kirschst.	
	Nemania Gray emend. pouzar	Nemania
	Obolarina Pouzar	Obolarina
?Paucithecium Lloyd		
Penzigia sacc.		*?Penzigia*
Phaeosporis Clem.	*Phaeosporis*	*Phaeosporis*
Phylacia Lev.	*Phylacia*	*Phylacia*
Pososordaria Ellis & Holw.	*Pososordaria*	*Pososordaria*
Poroconiochaeta Udagawa & Furuya		
Poronia Willd	*Poronia*	*Poronia*
Pulveria Malloch & Rogerson	*(as Phrenomyxa Morgan)*	*Pulveria*
Rhopalostroma D. Hawksw.	*Rhopalostroma*	*Rhopalostroma*
Rosellinia De Not.	*Rosellinia*	*Rosellinia*
Sarcoxylon Cooke	*Sarcoxylon*	*Sarcoxylon*
	?Seynesia Sacc.	

Stilbohypoxylon Henn.		?Stilbohypoxylon
Stromatoneurospora Jong & Davis	*Stromatoneurospora*	*Stromatoneurospora*
Thamnomyces Ehrenb.	*Thamnomyces*	*Thamnomyces*
Theissenia Maubl.	*Theissenia*	*Theissenia*
Thuemenella Penz. & Sacc.	*Thuemenella*	*Thuemenella*
Ustulina Tul. & C.Tul.		
Versiomyces Whalley & Watling		Versiomyces
Wawelia Namysl.	*?Wawelia*	*Wawelia*
Xylaria Hill ex Schrank	*Xylaria*	*Xylaria*

*Seynesia Sacc. is now accepted in the Xylariaceae (Hyde, 1995).

Table 2. Information of substrata, synonyme and anamorph stage of certain xylariaceous fungi as abstracted from literature

Species	Substrata	Synonyme	Anamorph stage
H. chestersii Rogers & Whalley	on *Fraxinus*		*Geniculosporium* sp. *fide* Whalley & Rogers
H. cohaerens (Pers.) Fr.	on *Fagus*, particularly in the south		?*Virgariella* sp. *fide* Jong & Rogers
H.confluens (Tode) Westend	on well rotted wood, especially *Quercus*	*H. semiimmersum* Nitschke	*Geniculosporium* sp. *fide* Chesters & Greenhalgh
H. confluens var. *microsporum* Rogers & Candoussau	on oak twigs		
H. fragiforme (Scop.) Kickx	on *Fagus*	*H. coccineum* Bull., *H. majusculum* Cooke	*Nodulisporium*sp. *fide* Jong & Rogers
H. fraxinophilum Pouzar	on recently fallen branches of *Fraxinus*	*H.argillaceum* (Pers.)Berks	*Virgariella* sp. *fide* Whalley
H. fuscum (Pers.) Fr.	on *Corylus* and *Alnus*		*Nodulisporium* sp. *fide* Greenhalgh & Chesters ?*Virgariella* sp. *fide*Jong & Rogers
H. gwyneddi Whalley, R.L.Edwads & S.Francis	on decaying *Fraxinus* wood		*Geniculosporium* sp. *fide* Whalley et al.
H. howeanum Peck	on various decidulous woods		*Nodulisporium* sp. *fide* Greengalgh & Chesters
H. mammatum (Wahlenb.) Miller	on *Populus* spp. and *Salix* sp.		
H. multifrome (Fr.) Fr.	on various trees, esp. *Betula*		*Nodulisporium* sp. *fide* Jong & Rogers
H. nummularium Bull.	on *Fagus*	*B. nummularia* (Bull.) O.	*Nodulisporium* sp. *fide*

		Kuntze *Nummularia bulliardii* Tul. & C. Tul	Jong & Rogers
H. rubiginosum (Pers.) Fr.	on decideous woods, esp. *Fraxinus*	*H. botrys* Nitschke, H. decroticatum (Schw.) Curtis, *H. perforatum* (Schw.) Fr.	*Virgariella* sp. *fide* Greenhalgh & Chester
H. rutilum Tul. & Tul.	on Fagus, infrequent	*H. miniatum* Cooke	
H.serpens (Pers.) Kickx	on decaying wood of deciduous trees		*Geniculosporium serpens* Chester & Greengalgh *fide* Chesters & Greengalgh
H. var. *effusum* (Nitschke) Miller	on *Salix*	*H. effusum* Nitschke	
H. stygium (Lev.) Sacc	on ?imported wood		
H. udum (Pers.) Fr.	on *Quercus*, usually well rotted wood		*Geniculosporium* sp. Whalley

Table 3. Information of geographical isolation of certain xylariaceous fungi as abstracted from literature.

Species	Region
Entonaema pallidum G.W.Martin	Panama, Trinidad
E. dengii J.D.Rogers	China
Hypoxylon atropunctatum (Schw.:Fr.) Cke.	North America
H. bartholomaei Peck	Western United States
H. beterostomum Mont.	Central and South America
H. hians (Berk.) Cke	Australia
H. melanaspis Mont.	Central and South America
H. philippinense (Ricker) Mill.	Philippine Islands
H. pynaethii Bres.	Central Africa
H. udum Pers.:Fr.	Europe
Rhopalostroma spp. D.Hawksw	Africa and Asia
Xylaria brasiliensis (Theiss.) Lloyd	Brazil, Sierra Leone