Saprobic fungi on bamboo culms

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This paper examines the taxonomic composition of saprobic fungi on dead culms of *Bambusa* spp. and *Dendrocalamus* spp. in the Philippines and in Hong Kong. A total of 2044 collections of saprobic fungi were made, comprising 24 ascomycetes, 56 mitosporic taxa, and 1 basidiomycete. The most commonly encountered ascomycete families on both hosts and at both sites were the *Xylariaceae* and *Valsaceae*, which were represented by 20% and 21.7% of the total collections, respectively. Other common families were the *Amphisphaeriaceae* (8.9%) and *Chaetomiaceae* (11.9%). The most common hyphomycetes on both hosts at both sites were *Acrodictys bambusicola* (9.6%), *Curvularia lunata* (9%), *Cladosporium cladosporioides* (8.3%), *Corynespora foveolata* (7.9%), *Ellisembia vaginata* (6.1%), *Phaeoisaria philippinensis* (6.5%), and *Acremonium kiliense* (6%). With the exception of *Diplozythiella bambusina* which was observed on *Bambusa* at both sites, the genera of coelomycetes differed at both sites. Species of *Bambusa* from both sites yielded more collections of saprobic fungi (1537), than did *Dendrocalamus* (507). Differences in the mycota between the two sites were observed. Collections of saprobes on both hosts in the Philippines were higher (1278) than in Hong Kong (766).

Key Words: bambusicolous fungi, fungal distribution, microfungi, tropical fungi.

Introduction

Knowledge of bamboo fungi is limited and it is only recently that mycologists have exhaustively catalogued fungi on bamboo. Eriksson and Yue (1997) reexamined all ascomycetes described from bamboo and provided an annotated checklist, while Boa (1964, 1967) listed common pathogens. There have been several taxonomic studies on bamboo fungi, but these are usually limited to specific localities, e.g. France (Petrini *et al.*, 1989), Japan (e.g. Hino and Katumoto, 1961) and the Philippines (e.g. Rehm, 1913, 1914; Sydow and Sydow, 1913, 1914).

There has been no comprehensive review of literature on bamboo fungi and there is no data on the distribution of fungi on bamboo in the tropics. A study was therefore initiated to examine and compare the fungi on two bamboo

hosts in the Philippines with fungi on the same host genera in subtropical Hong Kong.

Materials and methods

Collections were made at Mt. Makiling, Los Baños, Laguna, Luzon, the Philippines, in June 1995 and June 1996, and at Tai Po Kau Nature Reserve, Hong Kong, in September 1995 and October 1996. These months are well into the wet seasons at both sites. Initial studies had established that higher diversity and range of fungi in good condition could be found during wet seasons. The hosts in each site belonged to the same genera, *Bambusa* and *Dendrocalamus*, but were different species.

Makiling Forest Reserve on Mt. Makiling is a rich and ecologically important forest, owned and administered by the University of the Philippines (Lantican, 1974). Mt. Makiling has considerable scientific value with 3,050 plant species representative of Philippine flora (Lantican, 1974).

Hong Kong has a subtropical monsoonal climate dominated by two monsoons: warm rain-bearing south-easterlies in the summer and cold, dry north-easterlies in winter. Tai Po Kau Nature Reserve is the oldest nature reserve in Hong Kong and has more than 100 tree species, comprising a mixture of recent and long established plantings.

Sampling procedures

Three clumps of bamboo were chosen in an area of forest and three dead culms were randomly selected from each clump and cut down. Sixty samples (20-22 × 2.5-3 cm) were randomly cut from the length of each culm. Each sample was placed in an individual snap lock plastic bag with wet paper tissue, and incubated. After of 1-2 weeks of incubation, samples were examined under a dissecting microscope. Voucher slides and fungal specimens are deposited in the University of Hong Kong Mycological Herbarium [HKU(M)].

Statistical analysis

A data matrix consisting of the numbers of colonised tissue pieces from each sample unit (i.e. leaf or petiole of either one of the two sites) in rows and fungi in columns was subjected to ordination using correspondence analysis. Sample unit and fungal species ordinations were obtained simultaneously, therefore the ecological interrelationships between sample units and fungal species can be examined in a single analysis.

Results and discussion

Diversity of fungi on Bambusa *and* Dendrocalamus *spp.*

Examination of dead culms of *Bambusa* and *Dendrocalamus* from the Philippines and Hong Kong yielded 81 fungal taxa, comprising 56 mitosporic taxa, 24 ascomycetes and one basidiomycete (Table 1). Two hundred and sixty-two taxa have been previously recorded on these host genera, including 98 mitosporic taxa, 130 ascomycetes and 34 basidiomycetes (Dalisay, 1998).

Species from 12 ascomycete families were recorded in the present study (Fig. 1). The *Xylariaceae* was represented by six species, while the *Mycosphaerellaceae* and *Annulatascaceae* were each represented by three species. The *Valsaceae* and *Xylariaceae* were the most commonly collected families, represented by 59 and 52 collections, respectively (Fig. 2).

Previously 30 ascomycete families have been found on *Bambusa* and five families on *Dendrocalamus* (Dalisay, 1998). The *Xylariaceae* (represented by six genera) and *Hypocreaceae* (5) were previously the best-represented families on *Bambusa* spp. Two hypocreaceous genera had been previously encountered on *Dendrocalamus*, while the *Hysteriaceae*, *Lophiostomataceae*, *Paradiopsidaceae*, *Phyllachoraceae* and *Lasiosphaeriaceae* were each represented by a single genus (Dalisay, 1998).

In studies on palms, *Lasiosphaeriaceae* was the most common family in terms of genera (11), followed by the *Xylariaceae* (7) and *Hyponectriaceae* (7) (Fröhlich and Hyde, 2000). In terms of number of species, high counts were observed in the *Hypocreaceae, Hyponectriaceae*, *Meliolaceae, Mycosphaerellaceae* and *Xylariaceae* (Fröhlich and Hyde, 2000). Members of the *Lasiosphaeriaceae* and *Xylariaceae* are, therefore, commonly encountered genera on both palms and bamboos. The *Xylariaceae* is a family with a strong tropical representation (Whalley, 1997). Current data on the *Xylariaceae* indicate that at least three-quarters of the xylariaceous genera have representatives in the tropics (Whalley, 1997).

Fourteen ascomycete genera were found in the present study. Genera represented by more than one species were *Anthostomella* (4), *Guignardia* (3), *Massarina* (2), *Astrosphaeriella* (2), *Annulatascus* (2) and *Arecophila* (2). There were 59 collections of *Endothia singularis*, 39 collections of *Anthostomella* species, 41 collections of *Arecophila* species, 40 collections of *Chaetomium globulosum* and 30 collections of *Massarina*. Genera common to this study and in previous studies on bamboo fungi were *Anthostomella*, *Apiospora*, *Astrosphaeriella*, and *Hypoxylon* (Dalisay, 1998). *Anthostomella* and *Massarina* species were also common saprobes of palms (Fröhlich and Hyde, 2000).

Table 1. Fungal saprobes, in decreasing order of collections, identified from *Bambusa* spp. (B) and *Dendrocalamus* spp. (D) in Hong Kong and the Philippines.

	Hong Kong							Philippines							
Year	1995	1996	1995	1996	Total	Total	Total	1995	1996	1995	1996	Total	Total	Total	Grand
Bambusa (B) or *Dendrocalamus* (D)	B	B	D	D	B	D		B	B	D	D	B	D		Total
Taxa															
Acrodictys bambusicola	16	18	5	30	34	35	**69**	30	28	25	16	58	41	**99**	168
Curvularia lunata	20	16	4	19	36	23	**59**	36	31	13	17	67	30	**97**	156
Cladosporium cladosporioides	31	28	9	26	59	35	**94**	18	21	8	4	39	12	**51**	145
Corynespora foveolata	0	0	7	7	0	14	**14**	32	50	26	15	82	41	**123**	137
Phaeoisaria sp.	22	25	0	0	47	0	**47**	39	27	0	0	66	0	**66**	113
Acremonium kiliense	0	0	0	0	0	0	**0**	39	31	25	9	70	34	**104**	104
Ellisembia vaginata	10	2	5	5	12	10	**22**	42	40	0	0	82	0	**82**	104
Gliomastix fusigera	7	22	8	7	29	15	**44**	14	10	10	13	24	23	**47**	91
Acrodictys globulosa	36	19	0	0	55	0	**55**	9	8	0	0	17	0	**17**	72
Podosporium elongatum	19	27	8	14	46	22	**68**	0	0	0	0	0	0	**0**	68
Sporidesmium baccharidis	4	5	0	0	9	0	**9**	0	0	33	25	0	58	**58**	67
Endothia singularis (A)*	9	10	7	3	19	10	**29**	15	15	0	0	30	0	**30**	59
Corynespora cassiicola	6	8	9	4	14	13	**27**	3	27	0	0	30	0	**30**	57
Dactylaria triseptata	0	0	1	2	0	3	**3**	31	15	0	0	46	0	**46**	49
Podosporium nilgerense	19	15	3	4	34	7	**41**	0	0	0	0	0	0	**0**	41
Chaetomium globosum (A)	0	0	0	0	0	0	**0**	19	21	0	0	40	0	**40**	40
Brachysporiella guayana	5	2	0	0	7	0	**7**	25	5	0	0	30	0	**30**	37
Papulospora sp.	0	0	0	0	0	0	**0**	17	18	0	0	35	0	**35**	35
Arecophila philippinensis (A)	0	0	0	0	0	0	**0**	23	9	0	0	32	0	**32**	32
Acrodictys erecta	0	0	0	0	0	0	**0**	10	19	0	0	29	0	**29**	29
Acrodictys fimicola	6	8	0	0	14	0	**14**	4	7	0	0	11	0	**11**	25
Rhizosphaera pini	0	0	0	0	0	0	**0**	7	8	3	2	15	5	**20**	20
Trichocladium asperum	8	7	0	0	15	0	**15**	1	4	0	0	5	0	**5**	20
Massarina desmonci (A)	2	4	0	0	6	0	**6**	8	2	3	0	10	3	**13**	19
Anthostomella longipileata (A)	0	0	0	0	0	0	**0**	6	12	0	0	18	0	**18**	18

Table 1, contimued

	Hong Kong							Philippines							
Year	1995	1996	1995	1996	Total	Total	Total	1995	1996	1995	1996	Total	Total	Total	Grand
Bambusa (B) *or Dendrocalamus* (D)	B	B	D	D	B	D		B	B	D	D	B	D		Total
Taxa															
Stagonospora caricinella	0	0	0	0	0	0	**0**	9	8	0	0	17	0	**17**	17
Monodictys levis	0	7	0	0	7	0	**7**	3	6	0	0	9	0	**9**	16
Septoria sp.	0	0	0	0	0	0	**0**	6	10	0	0	16	0	**16**	16
Stilbella bambusae	0	0	0	0	0	0	**0**	4	4	6	2	8	8	**16**	16
Sporidesmium bambusicola	0	0	0	0	0	0	**0**	6	0	6	2	6	8	**14**	14
Anthostomella breviffisura (A)	3	10	0	0	13	0	**13**	0	0	0	0	0	0	**0**	13
Stachybotrys chartarum	0	0	0	0	0	0	**0**	7	6	0	0	13	0	**13**	13
Astrosphaeriella stellata (A)	0	3	3	5	3	8	**11**	0	0	0	0	0	0	**0**	11
Massarina arundinariae (A)	0	0	0	0	0	0	**0**	7	4	0	0	11	0	**11**	11
Annulatascus hongkongensis (A)	6	4	0	0	10	0	**10**	0	0	0	0	0	0	**0**	10
Ellisembia paravaginata	0	0	0	0	0	0	**0**	5	5	0	0	10	0	**10**	10
Hypoxylon fuscopurpureum (A)	5	5	0	0	10	0	**10**	0	0	0	0	0	0	**0**	10
Pleurophragmium bitunicatum	2	2	0	0	4	0	**4**	6	0	0	0	6	0	**6**	10
Arecophila bambusae (A)	0	0	0	0	0	0	**0**	5	4	0	0	9	0	**9**	9
Arthrinium phaeospermum	0	0	3	6	0	9	**9**	0	0	0	0	0	0	**0**	9
Endophragmiella oblonga	0	5	0	0	5	0	**5**	0	0	3	1	0	4	**4**	9
Pseudothyrium sp.	4	5	0	0	9	0	**9**	0	0	0	0	0	0	**0**	9
Berkleasmium concinnum	4	1	2	1	5	3	**8**	0	0	0	0	0	0	**0**	8
Rhizosphaera kalkhoffii	0	0	0	0	0	0	**0**	4	1	1	2	5	3	**8**	8
Curvularia pallescens	0	0	0	0	0	0	**0**	5	2	0	0	7	0	**7**	7
Diplozythiella bambusina	3	4	0	0	7	0	**7**	0	0	0	0	0	0	**0**	7
Exserticlava triseptata	0	0	1	2	0	3	**3**	3	1	0	0	4	0	**4**	7
Guignardia manokwaria (A)	0	0	0	0	0	0	**0**	7	0	0	0	7	0	**7**	7
Anthostomella contaminans (A)	1	5	0	0	6	0	**6**	0	0	0	0	0	0	**0**	6
Chlamydomyces palmarum	0	0	0	0	0	0	**0**	0	0	6	0	0	6	**6**	6
Dictyosporium elegans	0	2	0	0	2	0	**2**	3	0	1	0	3	1	**4**	6

Table 1, continued

	Hong Kong							Philippines							
Year	1995	1996	1995	1996	Total	Total	Total	1995	1996	1995	1996	Total	Total	Total	Grand
Bambusa (B) *or Dendrocalamus* (D)	B	B	D	D	B	D		B	B	D	D	B	D		Total
Taxa															
Pithomyces graminicola	0	0	2	4	0	6	**6**	0	0	0	0	0	0	**0**	6
Libertella heveae	0	0	0	0	0	0	**0**	5	0	0	0	5	0	**5**	5
Roussoella minutella (A)	3	2	0	0	5	0	**5**	0	0	0	0	0	0	**0**	5
Bertia sp. (A)	0	0	4	0	0	4	**4**	0	0	0	0	0	0	**0**	4
Gliomastix murorum	0	0	0	0	0	0	**0**	0	0	4	0	0	4	**4**	4
Annulatascus sp. (A)	0	0	0	0	0	0	**0**	0	3	0	0	3	0	**3**	3
Diplococcium dendrocalami	0	0	0	0	0	0	**0**	1	0	2	0	1	2	**3**	3
Exserticlava vasiformis	3	0	0	0	3	0	**3**	0	0	0	0	0	0	**0**	3
Guignardia sp. (A)	0	0	0	0	0	0	**0**	0	3	0	0	3	0	**3**	3
Guignardia philippinensis (A)	0	0	0	0	0	0	**0**	1	2	0	0	3	0	**3**	3
Lasmenia balansae	3	0	0	0	3	0	**3**	0	0	0	0	0	0	**0**	3
Rosellinia chusqueae (A)	2	1	0	0	3	0	**3**	0	0	0	0	0	0	**0**	3
Sporoschisma saccardoi	0	3	0	0	3	0	**3**	0	0	0	0	0	0	**0**	3
Anthostomella philippinensis (A)	0	0	0	0	0	0	**0**	2	0	0	0	2	0	**2**	2
Alveophoma caballeroi	0	0	0	0	0	0	**0**	2	0	0	0	2	0	**2**	2
Canalisporium caribense	2	0	0	0	2	0	**2**	0	0	0	0	0	0	**0**	2
Helicosporium panacheum	0	0	0	0	0	0	**0**	2	0	0	0	2	0	**2**	2
Hyalopcynis blepharistoma (B)	0	0	0	0	0	0	0	0	0	2	0	0	2	**2**	2
Pithomyces maydicus	0	0	0	0	0	0	**0**	2	0	0	0	2	0	**2**	2
Apiospora sp. (A)	1	0	0	0	1	0	**1**	0	0	0	0	0	0	**0**	1
Appendispora frondicola (A)	1	0	0	0	1	0	**1**	0	0	0	0	0	0	**0**	1
Astrosphaeriella cf. *nypae* (A)	0	0	1	0	1	0	**1**	0	0	0	0	0	0	**0**	1
Bactrodesmium spilomeum	1	0	0	0	1	0	**1**	0	0	0	0	0	0	**0**	1
Cercosporidium guanicense	0	0	0	0	0	0	**0**	0	1	0	0	1	0	**1**	1
Gilmaniella bambusae	1	0	0	0	1	0	**1**	0	0	0	0	0	0	**0**	1
Hapalosphaeria deformans	0	0	0	0	0	0	**0**	0	0	0	1	0	1	**1**	1

Table 1, continued

	Hong Kong							Philippines							
Year	1995	1996	1995	1996	Total	Total	Total	1995	1996	1995	1996	Total	Total	Total	Grand
Taxa															
Bambusa (B) *or Dendrocalamus* (D)	B	B	D	D	B	D		B	B	D	D	B	D		Total
Microthyrium sp. (A)	0	0	1	0	0	1	**1**	0	0	0	0	0	0	**0**	1
Piricaudiopsis appendiculata	0	0	0	0	0	0	**0**	1	0	0	0	1	0	**1**	1
Sporoschisma mirabile	1	0	0	0	1	0	**1**	0	0	0	0	0	0	**0**	1
Tetraploa javanica	1	0	0	0	1	0	**1**	0	0	0	0	0	0	**0**	1
Total species					**42**	**18**	**49**					**48**	**18**	**53**	
Total collections					**545**	**221**	**766**					**992**	**286**	**1278**	

A = Ascomycete; B = Basidiomycete; unmarked = mitosporic taxa.

Thirty-five hyphomycete genera were identified. The most common genus in terms of species and total collections was *Acrodictys* (4 species, 294 total collections). Other common genera were *Corynespora* (2 species, 194 collections), *Curvularia* (2, 163), *Cladosporium* (1, 145), *Podosporium* (2, 109), *Ellisembia* (2, 104), *Phaeosaria* sp. (1, 113) and *Acremonium* (1, 104). Common bambusicolous genera identified in this study and in previous studies are *Acrodictys*, *Arthrinium*, *Cladosporium*, *Corynespora*, *Fusarium*, *Gliomastix*, *Helicosporium*, *Periconia*, *Phaeoisaria*, *Pithomyces*, *Podosporium*, *Sporidesmium* and *Stilbella* (Dalisay, 1998).

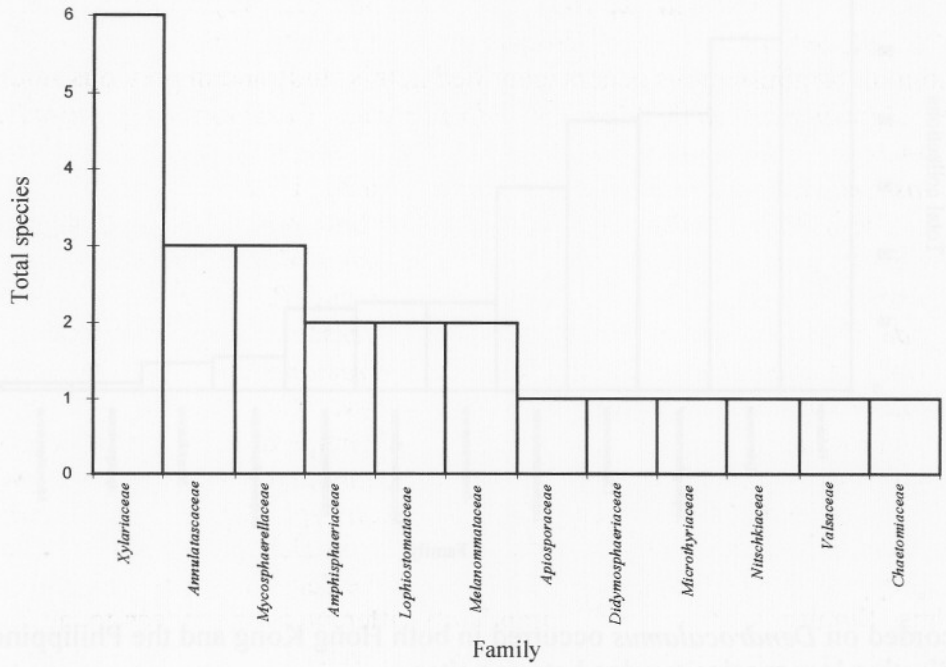
The most frequently recorded species on both hosts in Hong Kong were *Acrodictys bambusicola*, *Cladosporium cladosporioides*, *Curvularia lunata*, *Gliomastix fusigera*, *Podosporium elongatum* and *P. nilgerense* (Table 1). *Acrodictys globulosa* and *Phaeoisaria philippinensis* were frequently recorded, but only on *Bambusa* sp. In the Philippines *Acremonium kiliense*, *Acrodictys bambusicola*, *Cladosporium cladosporioides*, *Corynespora foveolata*, *Curvularia lunata* and *Gliomastix fusigera* were frequently recorded species on both hosts. *Dactylaria triseptata*, *Ellisembia vaginata* and *Phaeosaria* sp. were frequently recorded, but only on *Bambusa* sp., while *Sporidesmium baccharidis* was frequently recorded, but only on *Dendrocalamus* sp. These fungi appear to be a "core group" involved in the degradation of dead bamboo culms. Similar "core groups" comprising different fungi appear to degrade other substrata, e.g. submerged wood in freshwater (Wong *et al.*, 1998) and dead grasses (Wong and Hyde, 2001).

***Fungi on* Bambusa**

A total of 1537 collections of fungi were recorded on *Bambusa*. Samples of *Bambusa* collected in Hong Kong yielded 545 collections (Table 1). The most dominant species were *Acrodictys bambusicola*, *A. globulosa*, *Cladosporium cladosporioides*, *Curvularia lunata*, *Phaeosaria* sp., *Podosporium elongatum* and *P. nilgerense*. These species have been encountered in previous studies on *Bambusa* spp., with the two species of *Podosporium* specifically recorded on dead culms (Penzig and Saccardo, 1901; Chen and Tzean, 1993).

Samples of *Bambusa* collected in the Philippines yielded 992 collections of fungi (Table 1). The most dominant species were *Acremonium kiliense*, *Acrodictys bambusicola*, *Corynespora foveolata*, *Curvularia lunata*, *Ellisembia vaginata* and *Phaeosaria* sp.

Fig. 1. Number of species per ascomycete family collected in this study.



Most of the fungi recorded on *Bambusa* were restricted to either Hong Kong or the Philippines. Only 17 (27%) of the total 63 species recorded on *Bambusa* occurred in both Hong Kong and the Philippines indicating low species overlap between sites.

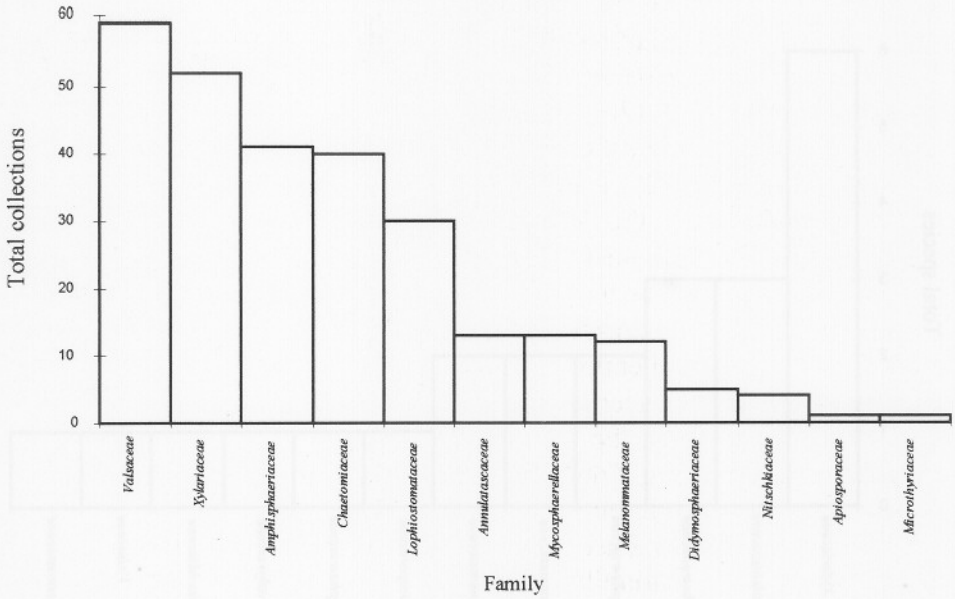
***Fungi on* Dendrocalamus**

A total of 507 collections were recorded on *Dendrocalamus* at both sites. Samples of *Dendrocalamus* collected in Hong Kong yielded 221 collections (Table 1). The most dominant species were *Acrodictys bambusicola*, *Cladosporium cladosporioides*, *Curvularia lunata* and *Podosporium elongatum*.

Samples of *Dendrocalamus* collected in the Philippines yielded 286 collections of fungi (Table 1). The most dominant species were *Acremonium kiliense*, *Acrodictys bambusicola*, *Corynespora foveolata*, *Curvularia lunata*, and *Sporidesmium baccharidis*.

Most of the fungi recorded on *Dendrocalamus* were restricted to either Hong Kong or the Philippines. Only five (15.6%) of the total 32 species

Fig. 2. Number of collections of ascomycete families.



recorded on *Dendrocalamus* occurred in both Hong Kong and the Philippines indicating low species overlap between sites.

Comparison of fungi in the Philippines and Hong Kong

The total number of collections of fungal taxa at the two sites are presented in Table 1. There were 766 collections of taxa in Hong Kong and 1278 from the Philippines. Mitosporic fungi were most frequently recorded at both sites, followed by ascomycetes. The diversity of fungi in the Philippines (53 taxa) was similar to that in Hong Kong (49), however the number of collections in the Philippines was much larger than that in Hong Kong. The differences in numbers of fungal collections occurring on similar samples and genera of bamboo collected in Hong Kong and the Philippines may be influenced by climate. Hong Kong is subtropical, whereas the Philippines is tropical. Although both have distinct dry and wet seasons, the climate of Hong Kong is more characteristic of the subtropics, or an intermediate "transitional tropics" zone (Dudgeon and Corlett, 1994).

The similar diversity of fungi on bamboo in the Philippines (tropical) and Hong Kong (subtropical) can be compared with previous studies on various substrata. Fröhlich and Hyde (2000) identified more fungi from palms in Brunei (tropical), than in Hong Kong, however, the sample sizes were variable.

A similar diversity of fungi were found on wood submerged in freshwater streams in Hong Kong and those in the tropics (Tsui *et al.*, 2000). These differences may however, be in part, reflections of the intensity of studies, as they do not involve standardized collecting and examination protocols.

Overlap of species between hosts and sites were low (Table 1). Of the 81 taxa identified, only 21 (26%) occurred both in the Philippines and Hong Kong. Of the 49 taxa identified in Hong Kong, only 11 (22.5%) occurred on both hosts. Most taxa (42) occurred on *Bambusa*, while only 18 taxa occurred on *Dendrocalamus*. Of the 53 taxa identified in the Philippines, only 13 (24.5%) occurred on both hosts in Hong Kong. Most taxa (48) also occurred on *Bambusa*, while only 18 taxa occurred on *Dendrocalamus* in the Philippines.

Three-dimensional correspondence analysis was performed to visualize the effect of host and collection site on the colonization of fungi (Fig. 3). The first three principle axes accounted for 78% (x-axis: 35%, y-axis: 27%, z-axis: 16%) of the variability in the data matrix. X-axis clearly separates the fungal communities of the Hong Kong site from those of the Philippines site. Y-axis separates the fungal communities on *Bambusa* sp. and *Dendrocalamus* sp. in the Philippines, whereas Z-axis separates the fungal communities on the two hosts in Hong Kong. Variability between sites is similar on the two hosts, as expressed by the similar distances between the points representing *Bambusa* and *Dendrocalamus* from the two sites. All the fungal communities on samples collected in 1995 form closely coherent clusters with the corresponding samples collected in 1996.

The low overlap of fungi on the two hosts has important implications for diversity estimates since both hosts occurred in the same site and yet supported generally different fungi. Biodiversity estimates of fungi rely largely on extrapolation of hosts to fungi ratios, which are thought to be in the region of 1:6 (Hawksworth, 1991; Fröhlich and Hyde, 1999). For such a ratio to exist there must be a relatively high degree of host specificity or recurrence of fungi on particular hosts (Photita *et al.*, 2001). The evidence here indicates that there is relatively low overlap between the fungi that occur on the same bamboo genera in different countries and on different genera in the same sites. This provides support for the estimates of six fungi to each vascular plant host used amongst other data by Hawksworth (1991) in estimating fungal numbers.

Saprobic fungi on bamboo

The mitosporic taxa encountered in this study which have previously been recorded on *Bambusa* species were *Stilbella bambusae* (on leaves), *Corynespora foveolata* (on culms) and *Gliomastix fusigera* (on an unknown substrate) (Ellis, 1971; Farr *et al.*, 1989; Seifert, 1985). Several hyphomycetes

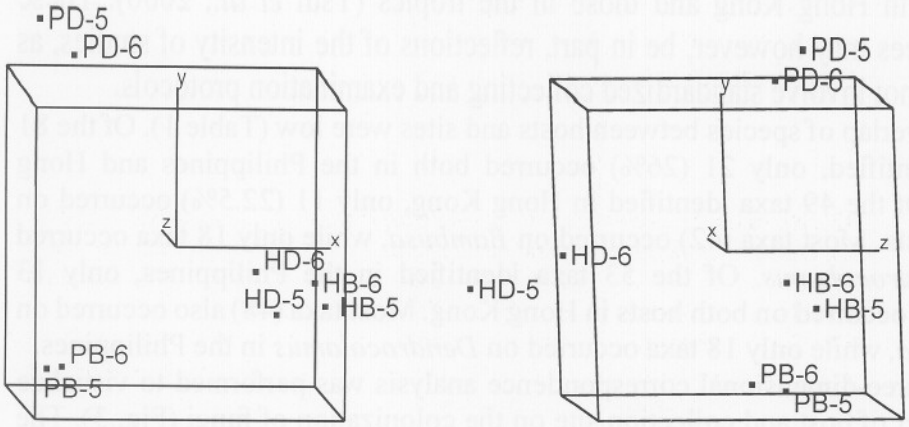


Fig. 3. Three dimensional correspondence ordination of fungal communities recorded on *Bambusa* sp. and *Dendrocalamus* sp. in Hong Kong and the Philippines. **3a.** Diagram oriented at x- and y-axes. **3b.** Diagram oriented at y- and z-axes.

recorded in this study have been previously recorded on bamboo, although on different species or unnamed species. *Arthrinium arundinis*, *Canalisporium caribense* and *Exserticlava triseptata* have been identified from species of *Arundinaria* (Hughes, 1978; Kirk, 1985; Farr *et al.*, 1989). *Arthrinium phaeospermum* has been recorded on species of *Phyllostachys* (Ellis, 1971). *Acrodictys bambusicola*, *A. fimicola*, *Curvularia pallescens* and *Podosporium elongatum* have been recorded from unnamed species of bamboo (Ellis, 1971; Chen and Tzean, 1993).

The only ascomycete species found in this study which has previously been recorded on *Bambusa* species is *Astrosphaeriella stellata* (Hyde and Fröhlich, 1998). Some ascomycetes identified in earlier studies were also found in this study, but they were previously recorded from different bamboo species. For example, *Rosellinia chusquea* has been recorded on *Chusquea* sp., *Massarina arundinariae* on *Arundinaria* sp., and *Hypoxylon fuscopurpureum* on *Phyllostachys bambusoides*, *P. bambusoides* var. *marliaceae* f. *katasibo*, *Pseudosasa japonica*, *Sasa kurilensis* and *S. borealis* var. *purpurascens* (Barr, 1992).

The basidiomycete *Hyalopycnis blepharistoma* has not been previously observed on bamboo.

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