Malaysian Mangrove Fungi

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Eighty two fungi growing on mangrove wood collected at various sites in Malaysia are recorded. The most frequently collected species was the marine basidiomycete *Halocyphina villosa*. Other fungi commonly collected included: *Hydronectria tethys*, *Lulworthia grandispora*, *Hypoxylon oceanicum*, *Halosarpheia marina*, *Didymosphaeria enalia*, *Savoryella lignicola*, *Lignincola laevis* and *Dactylospora haliotrepha*. Twenty three fungi were recorded only once in this study and forty nine are new records for Malaysia.

The last two decades have seen considerable interest in the fungi occurring on intertidal mangrove wood, be it drift or attached wood (Kohlmeyer, 1969, 1984, 1985; Hyde & Jones, 1986, 1987, 1988; Kohlmeyer & Kohlmeyer, 1965; Kohlmeyer & Schatz, 1985; Kohlmeyer & Volkmann-Kohlmeyer, 1987) or on submerged test blocks of mangrove wood (Leightley, 1980; Leong & al., 1989a, b). To date some 90 intertidal mangrove fungi are known (Hyde & Jones, 1988) although further species await description (Hyde, unpublished: Jones, unpublished). Studies to date have been largely taxonomical (Kohlmeyer, 1984) although some workers have tried to quantify their results (Jones & Tan, 1987; Hyde & Jones, 1988; Jones & al., 1988). This study provides further information on the occurrence of mangrove fungi at various sites in Malaysia. Previous studies have yielded 34 species for Malaysia (Tan, 1985; Jones & Tan, 1987).

Material and Methods

Collections were carried out at four locations in Malaysia, mostly during the monsoon season of October to December, 1985–87. The collections were restricted to driftwood, intertidal and attached mangrove material and consisted of twigs from a few millimetres in diameter to small branches 15 cm in diameter. Collected material was placed in sterile plastic bags for transport to the laboratory. Samples were gently washed to remove any adhering soil particles, major fouling organisms were scraped off and the wood incubated for up to six months at 27° C in sterile plastic containers. Slides of all fungi were prepared and are held in the Herbarium of the

Institute of Advanced Studies, University Malaya. Collections were made at the following sites: Sungei Geylang Patah, Johore Baru; Kuala Selangor, Selangor; For Dickson, and Kampong Sementa, Klang.

Results

Tab. 1 lists the fungi collected at all four sites. Eighty two species were collected although not all were identified to species level. Some are undoubtedly new to science and await description or have been recently described (e. g. *Hypoxylon oceanicum* SCHATZ, 1988; unidentified Ascomycotina) while insufficient material of some species was available for study (e. g. *Cirrenalia* sp., new hyphomycete). The most abundant group of fungi collected were the Ascomycotina (56 species) with twenty four Deuteromycotina and two Basidiomycotina. Sclerocarps were also found on some of the wood samples.

Seventeen species were recorded in each of the three years and at more than 4 sites. Of these, the most frequently collected species was *Halocyphina villosa* (a basidiomycete) with *Hydronectria tethys, Lulworthia grandispora, Hypoxylon oceanicum, Didymosphaeria enalia, Savoryella lignicola, Lignincola laevis* and *Dactylospora haliotrepha* as common. Nearly half of the fungi listed in Tab. 1 were found at only one site and restricted to one collection.

Discussion

This type of study is relevant to obtain the broad spectrum of species present on lignocellulosic material in the mangrove ecosystem. Comparisons of data from the examination of intertidal drift or attached wood yields a much greater number of species than those on submerged test blocks in the sea. Each approach has its merits. Baiting with test blocks submerged in the sea enables the investigator to follow the sequence of colonization by fungi with supporting information on date of submergence, origin of the substratum and the physical parameters of the test site. However, the procedure is often limiting in that only a narrow range of timber species can be tested and the period of exposure is often restricted. Examination of driftwood has limitations in that no information is available on the length of exposure, the origin or the identification of the substratum. However, it does give a broader picture of the organisms involved in the colonization of substrata in the mangrove ecosystem.

LEONG & al. (1989) and TAN & al. (1989) recorded 35 species on test blocks of *Avicennia alba, A. lanata, Bruguiera cylindrica* and *Rhizophora apiculata* exposed in Mandai mangrove, Singapore. Approximately half of these (18) were only recorded once on the test

Tab. 1. Marine Fungi Collected From Driftwood, Standing Trees of Mangroves for 1985, 1986, 1987.

Species	1985	1986				1987					Total Collections (1986, 1987)
		a	b	c	d	1	2	3	4	5	
Halocyphina villosa KOHLM. & KOHLM.	+	–	14	11	13	40	13	–	5	17	113
Hydronectria tethys KOHLM. & KOHLM.	+	3	5	9	4	22	4	2	3	3	76
Lulworthia grandispora MEYERS	+	–	6	7	12	7	5	14	–	–	51
Hypoxylon oceanicum SCHATZ	+	3	7	7	4	12	5	1	–	5	44
Halosarpheia marina (CRIBB & CRIBB) KOHLM.	+	3	7	11	16	1	1	–	–	–	39
Didymosphaeria enalia KOHLM.	+	7	1	1	4	12	–	–	1	2	27
Savoryella lignicola JONES & EATON	+	2	–	8	9	16	3	–	1	–	39
Lignincola laevis HÖHNK	+	6	4	–	5	6	–	13	–	–	34
Dactylospora haliotrepha (KOHLM. & KOHLM.) HAFELLNER	+	1	2	4	5	24	3	–	4	2	45
Trichocladium achrasporum (MEYERS & MOORE) DICON	+	2	–	10	6	6	–	–	–	–	24
Halosarpheia ratnagiriensis PATIL & BORSE	+	–	–	–	3	9	2	1	–	–	15
Aigialus parvus SCHATZ & KOHLM.	+	1	2	–	–	3	2	1	–	–	9
Leptosphaeria sp.	+	–	–	1	3	3	1	1	–	–	9
Phoma sp.	+	–	–	–	2	4	1	1	–	1	9
Aniptodera mangrovei HYDE	+	1	–	5	–	3	–	–	–	–	9

Savoryella paucispora (Cribb & Cribb) Koch	+	–	–	–	5	1	1	–	–	–	7
Cirrenalia sp.	+	–	–	–	1	–	1	–	–	–	2
* *Periconia prolifica* Anastasiou	–	–	5	1	1	1	2	8	–	1	19
Lignincola longirostris (Cribb & Cribb) Kohlm.	–	–	–	–	–	12	–	–	–	1	13
* *Halosarpheia retorquens* Shearer & Crane	–	–	1	–	7	4	–	–	–	–	12
* *Rhabdospora avicenniae* Kohlm. & Kohlm.	–	–	–	–	6	2	–	2	1	–	11
* *Marinosphaeria mangrovei* Hyde	–	–	–	1	–	5	1	5	–	6	18
* *Lulworthia medusa* (Ellis & Everhart) Cribb & Cribb	–	1	10	–	1	–	–	–	–	–	12
* *Zalerion varium* Anastasiou	–	1	1	4	3	1	–	–	–	–	10
* *Monodictys* sp.	–	–	–	1	–	7	1	–	–	–	9
* *Xylomyces* sp.	–	1	4	–	1	2	–	–	–	–	8
* *Halosarpheia minuta* Leong	–	–	–	–	–	4	1	1	2	–	8
Cystospora rhizophorae Kohlm. & Kohlm.	+	–	2	4	–	–	–	–	–	–	6
* *Swampomyces armeniacus* Kohlm. & Volk.–Kohlm.	–	–	–	2	4	–	–	–	1	–	7
* *Trematosphaeria lignatilis* Kohlm.	–	1	5	–	1	–	–	–	–	–	7
* *Zalerion maritimum* (Linder) Anastasiou	–	–	1	–	–	5	–	–	–	–	6
* Unidentified Ascomycotina	–	–	1	1	3	1	–	–	1	–	7
Cirrenalia pygmea Kohlm.	+	–	–	–	4	–	–	–	–	–	4
* *Cirrenalia pseudomacrocephala* Kohlm.	–	1	–	1	3	–	–	–	–	–	5

Species	1985	1986				1987					Total Collections (1986, 1987)
		a	b	c	d	1	2	3	4	5	
* *Lignincola tropica* KOHLM.	–	–	–	3	–	–	1	–	–	–	4
Cirrenalia tropicalis KOHLM.	+	1	–	1	1	–	–	–	–	–	3
Lulworthia sp. (Median range)	+	–	–	–	–	3	–	–	–	–	3
* *Cystospora* sp.	–	–	–	–	–	3	–	–	1	–	4
Leptosphaeria australiensis (CRIBB & CRIBB) HUGHES	+	–	–	–	–	2	1	–	–	–	3
* *Pleospora* sp.	+	–	–	–	–	–	1	1	–	–	2
* *Aggeratum* sp.	–	–	–	–	–	3	–	–	–	–	3
* *Belizeana tuberculata* KOHLM. & VOLK-KOHLM.	–	–	–	–	–	3	–	–	–	–	3
* *Halosarpheia fibrosa*-like	–	–	2	–	1	–	1	–	–	–	4
Sclerocarps	+	–	1	–	–	–	1	–	–	–	2
* *Aigialus grandis* KOHLM. & SCHATZ	+	–	1	–	–	–	–	–	–	–	1
Aniptodera chesapeakensis SHEARER & MILLER	+	–	–	–	1	–	–	–	–	–	1
Anthostomella sp.	–	–	–	–	–	1	–	1	–	–	2
* *Halosarpheia abonnis* KOHLM.	–	–	1	1	–	–	–	–	–	–	2
* *Halosarpheia* sp.	–	–	1	–	1	–	–	–	–	–	2
* *Humicola alopallonella* MEYERS & MOORE	–	1	–	–	1	–	–	–	–	–	2
* *Lanspora coronata* HYDE & JONES	–	–	1	–	1	–	–	–	–	–	2
* *Linocarpon* sp.	–	–	–	1	1	–	–	–	–	–	2

* *Lophiostoma mangrovis* Kohlm. & Vittal	–	–	–	–	–	2	–	–	–	–	2
* *Nais glitra* Crane & Shearer	–	1	–	–	1	–	–	–	–	–	2
* *Massarina thalassiae* Kohlm.	–	–	–	–	–	2	–	–	–	–	2
* *Payosphaeria minuta* Leong	–	–	–	–	–	2	–	–	–	–	2
* *Trichocladium linderi* Shearer	–	–	–	–	–	2	–	–	–	–	2
* *Aigialus* sp.											
* *Antennospora quadricornuta* (Cribb & Cribb) T. W. Johnson	–	–	–	–	1	–	–	–	–	–	1
* *Aniptodera* sp.	–	–	–	–	–	–	–	–	–	1	1
Biatriospora marina Hyde & Borse	+	–	–	–	–	–	–	–	–	–	–
* *Caryosporella rhizophorae* Kohlm.	–	–	–	–	–	–	–	–	1	–	1
* *Clavariopsis bulbosa* Anastasiou	–	–	–	–	–	–	–	1	–	–	1
* Cleistothecial Ascomycotina	–	–	–	–	–	–	1	–	–	–	1
Cucullospora mangrovei Hyde & Jones	+	–	–	–	–	–	–	–	–	–	–
* *Dendryphiella arenaria* Nicot	–	1	–	–	–	–	–	–	–	–	1
* Dematiaceous hyphomycete	+	–	–	–	–	–	–	–	–	–	–
* *Diatrype/Hypoxylon* sp. (cigar shaped ascospores)	–	–	–	–	–	1	–	–	–	–	1
Dictyosporium sp.	+	–	–	–	–	–	–	–	–	–	–
* *Fusarium* sp.	–	–	–	–	–	–	–	1	–	–	1
* *Halosarpheia lotica* Shearer	–	–	–	–	–	1	–	–	–	–	1
* *Halosaspheia trullifera* (Kohlm.) Jones, Moss & Cuomo	–	–	–	–	1	–	–	–	–	–	1

Species	1985	1986				1987					Total Collections (1986, 1987)
		a	b	c	d	1	2	3	4	5	
Helicascus kanaloanus KOHLM.	+	–	–	–	–	–	–	–	–	–	–
Leptosphaeria sp. 2	–	–	–	–	1	1	–	–	–	–	2
Leptosphaeria sp. 3	–	–	–	–	–	1	–	–	–	–	1
Massarina velataspora HYDE & BORSE	+	–	–	–	–	–	–	–	–	–	–
* *Massarina* sp.	–	–	–	–	–	–	1	–	–	–	1
* *Remispora quadriremis* KOHLM.	–	–	–	–	–	–	–	–	–	1	1
* *Sigmoidea* sp.	–	–	–	–	1	–	–	–	–	–	1
* *Trematosphaeria mangrovis* KOHLM.	–	–	–	–	–	1	–	–	–	–	1
* *Trichocladium* sp.	–	–	–	–	–	–	–	–	–	1	1
* New hyphomycete	–	–	1	–	–	–	–	–	–	–	1
Number of fungal occurrences		38	96	96	63	229	52	31	21	41	
Number of wood samples		31	53	63	118	201	34	34	15	78	
Fungi per sample		1.9	1.6	1.5	1.2	1.1	1.5	1.0	2.3		
Total species: 82.	32	50				53					

a. Kampong Sementa *Rhizophora apiculata* stand.
b. Kampong Sementa *Avicennia* stand.
c. Kuala Selangor, South side of river.
d. Kuala Selangor, North side of river.

1. Kuala Selangor.
2. Sementa, Klang general mangrove wood
3. Sementa, Klang *Avicennia* wood.
4. Fort Dickson, general mangrove wood.
5. Proproots of *Rhizophora mucronata*.

* New record for Malaysia.

blocks, a result similar to our examination of drift wood in this study. HYDE & JONES (1988) reported *Halocyphina villosa* as the most common fungus on drift mangrove wood in the Seychelles and a similar observation is made in this study. Frequent fungi in the Seychelles study were *Aniptodera mangrovei, Antennospora quadricornuta, Halosarpheia marina, Rhizophila marina* and *Lulworthia grandispora*. Only two of these were common in the present study (i. e. *H. marina* and *L. grandispora*).

LEONG & al. (1989) noted that the sequence of colonization of test blocks was as follows: early colonizers: *Lignincola laevis, Lulworthia* sp. 1, followed by *Didymosphaeria enalia, Halosarpheia mariana;* and intermediate colonizers: *Aigialus parvus,* Ascomycete No. 25, Ascomycete No. 494, *Aigialus mangrovis* and late colonizers: *Halocyphina villosa* and *Hypoxylon oceanicum*. With the exception of *A. mangrovis,* Ascomycete No. 25, and Ascomycete No. 494, all these were amongst the most frequently recorded species in the present study. A more detailed analysis of the current data indicates that examination of intertidal drift and attached mangrove material selects for the latter stages of fungal colonization of wood in the mangroves (e. g. *H. villosa, Hydronectria tethys, Hypoxylon oceanicum, Dactylospora haliotrepha, Halosarpheia ratnagiriensis, Savoryella lignicola, S. paucispora* and *Leptosphaeria* sp.) This is because the early colonising fungi occur on relatively sound wood which may not be so easy to collect (HYDE, 1988).

This study has shown that a wide range of fungi colonize mangrove substrata and that these are dominated by the Ascomycotina. A number of factors control the appearance of fungi on mangrove wood; (1) timber species, e. g. LEONG & al. (1989) showed that *Hypoxylon oceanicum* was particularly common on *Bruguiera cylindrica;* (2) length of exposure, e. g. *Lignincola laevis* is an early colonizer while *Halocyphina villosa* is an intermediate to late colonizer of wood; (3) geographic location, although there is little information on this subject and other factors may account for their occurrence; (4) salinity, again no evidence is available; and (5) vertical position in the mangrove (HYDE, 1988). Clearly further detailed studies at a number of locations are required to resolve the ecological niche of many of the fungi collected during this study. Some are more common on submerged wood, e. g. *Antennospora quadricornuta, Zalerion maritimum, Halosarpheia trullifera;* others may be more common on other substrata, e. g. *Sigmoidea* sp. (on algae), *Lindra* spp. (on leaf material).

A number of fungi have only recently been described and it is not possible to speculate as to their role in the mangrove ecosystem, e. g. *Aigialus grandis, Biatriospora marina, Caryosporella rhizophorae, Cucullospora mangrovei* and *Halosarpheia abonnis*. Aspects

that require investigation include the relationship between thickness of the substratum and fungal species; effects of the presence of cortical tissue and bark; and the degree of decay of the wood. For example, *Halosarpheia ratnagiriensis* is usually found on twigs and the ascocarps are deeply submerged in the wood, while *Savoryella lignicola* and *S. paucispora* are to be found on highly softened wood. This is surprising for *S. lignicola* as studies on exposed test blocks in cooling towers showed that the fungus was an early colonizer, superficial and often embedded in a layer of silt (JONES & EATON, 1969).

Of the 82 species collected in this study 23 showed an active mechanism for the release of ascospores or had an apical apparatus to the ascus. This is in marked contrast to the marine fungi found on submerged wood in coastal waters where deliquescent asci and passive release is the norm. Most of the 23 fungi with active discharge are bitunicate Ascomycotina which suggests an affinity with terrestrial fungi. A number of others have an apical apparatus to the ascus, although there is little information as to their ability to discharge spores through the pore, e. g. *Halosarpheia marina, H. ratnagiriensis, H. abonnis, Lignincola longirostris, L. tropica* and *Nais glitra*. This may be a further indication as to the intermediate position of these fungi between a terrestrial and fully aquatic existence. Many parts of the mangroves are only covered for up to two hours in any 24 hours, thus offering a niche for some terrestrial-like fungi for air dispersal of their spores. Further down the shore, where the mangroves are covered by water for 60% of the time, fungi with stronger affinities for an aquatic existence may occur. The mangroves offer a unique habitat for the growth of fungi as the number recorded testifies.

Eighty-six marine fungi have now been recorded for Malaysia. Eighty-two were collected in this study while TAN (1985) reportet *Corollospora intermedia* and *Nia vibrissa* from Penang and JONES & TAN (1987) collected *Aigialus grandis* from Sungei Geylang Patah.

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References

HYDE, K. D. (1988). Studies on the tropical marine fungi of Brunei. – Bot. J. Linn. Soc. 98: 135–151.

HYDE, K. D. & E. B. G. JONES (1986). Marine Fungi from Seychelles, IV. *Cucullospora mangrovei* gen. et sp. nov. from dead mangrove. – Bot. Mar. 29: 491–495.

HYDE, K. D. & E. B. G. JONES (1987). Marine fungi from Seychelles, VII. *Bathyascus grandisporus* sp. nov. from mangrove wood. – Bot. Mar. 30: 413–416.

HYDE, K. D. & E. B. G. JONES (1988). Marine mangrove fungi. – P. S. Z. N. I. Marine Ecology, 9: 15–33.

JONES, E. B. G. & R. A. EATON (1969). *Savoryella lignicola* gen. et sp. nov. from water-cooling towers. – Trans. Br. mycol. Soc. 52: 161–174.

JONES, E. B. G. & T. K. TAN (1987). Observations on manglicolous fungi from Malaysia. – Trans. Br. mycol. Soc. 89: 390–392.

JONES, E. B. G., F. R. UYENCO & M. P. FOLLOSCO (1988). Fungi on driftwood collected in the intertidal zone from the Philippines. – Asian Marine Biology 5: 103–106.

KOHLMEYER, J. (1969). Ecological notes on fungi in mangrove forests. – Trans. Br. mycol. Soc. 53: 237–250.

KOHLMEYER, J. (1984). Tropical marine fungi. – P. S. Z. N. I. Marine Ecology 5: 329–378.

KOHLMEYER, J. (1985). *Caryosporella rhizophorae* gen. et sp. nov. (Massariaceae), a marine ascomycete from *Rhizophora mangle*. – Proc. Indian Acad. Sci. (Plant Sci.) 94: 355–361.

KOHLMEYER, J. & E. KOHLMEYER (1965). New marine fungi from mangroves and trees along eroding shorelines. – Nova Hedwigia 9: 89–104.

KOHLMEYER, J. & S. SCHATZ (1985). *Aigialus* gen. nov. (Ascomycetes) with two marine species from mangroves. – Trans. Br. mycol. Soc. 85: 699–707.

KOHLMEYER, J. & B. VOLKMANN-KOHLMEYER (1987). Marine fungi from Belize with a description of two new genera of ascomycetes. – Bot. Mar. 30: 195–204.

LEONG, W. F., T. K. TAN & E. B. G. JONES (1989). Fungal succession on wood of *Bruguiera cylindrica* and *Rhizophora apiculata* submerged in Mandai mangrove, Singapore. – Bot. Mar. (in press).

LEIGHTLEY, L. (1980). Wood decay activities of marine fungi. – Bot. Mar. 28: 387–395.

SCHATZ, S. (1988). *Hypoxylon oceanicum* sp. nov. from mangroves. – Mycotaxon 33: 413–418.

TAN, T. K. (1985). Observations on marine fungi in Singapore and Penang (Malaysia). – Trans. Br. mycol. Soc. 85: 726–727.

TAN, T. K., W. F. LEONG & E. B. G. JONES (1989). Succession of fungi on wood of *Avicennia alba* and *A. lanata* in Singapore. – Can. J. Bot. (in press).