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Pattern of Fungal Colonization and Co-occurrence on *Avicennia officinalis* Woody Litter in a South-western Mangrove of India

G.L. Maria and K.R. Sridhar*

Department of Botany, St. Agnes College, Mangalore 575 002, Karnataka, India

Department of Biosciences, Mangalore University, Mangalagangotri 574 199, Mangalore, Karnataka, India

**Corresponding author Email: kandikere@gmail.com*

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ABSTRACT

This study outlines the pattern of colonization and co-occurrence of saprophytic fungi on woody litter of *Avicennia officinalis* tree species in Nethravathi mangrove. Two types of woody litter (naturally and artificially submerged) during two seasons (monsoon and summer) were assessed. Natural woody litter consists of 57 fungal species, while it was 34 species in submerged woody litter. Composition of fungi was a mosaic of typical marine and terrestrial fungi. Higher number of fungi (teleomorphs, anamorphs and core-group species) was found in natural than submerged wood, so also during monsoon than summer. Eight species (*Aniptodera* sp., *Lignincola laevis, Lulworthia grandispora, Savoryella lignicola, S. paucispora, Tricladium linderi*, *Tirispora* sp. and *Zalerion varia*) were common to natural and submerged wood in both seasons. The Shannon diversity was higher during monsoon than summer irrespective of type of wood assessed. The co-occurrence of fungi per wood was maximum up to 8 and 11 species during monsoon in submerged and natural wood, respectively. The pattern of three fungal species co-occurrence was also similar to overall colonization on woody litter. In both wood types, three species co-occurrence was the highest in both seasons. Per cent co-occurrence of 20 core-group species showed dominance in natural than in submerged wood, so also during monsoon than summer. Single species occurrence of core-group fungi on woody litter was as low as 0% (16 core-group fungi on either of wood or season) and 12% (*Lignincola laevis*). The core-group fungus *L. laevis* co-occurred up to a maximum of 72% during summer in natural wood which reveals its compatibility and accommodating ability with other associated fungi. Overall, this study reveals that the colonization and co-occurrence of fungi on woody litter in mangroves are dependent on the type of woody litter as well as the monitoring season.

Keywords: Diversity, mangrove fungi, species assemblage, species consortia, core-group fungi, monsoon, summer

INTRODUCTION

Mutualism is one of the evolutionary consequences which facilitated biological entities to live harmoniously to face unusual ecological and abiotic consequences. Mutualistic association of two or more species in an ecological niche is very common (e.g. plant species vs. arbuscular mycorrhizae/ectomycorrhizae/endophytic fungi). Among saprophytic fungi, co-occurrence or succession is inevitable to exploit detritus to a maximum extent. In this context, mangrove ecosystems provide excellent platform with wide variation in ecological, biotic and abiotic factors to investigate the activities and functions of saprophytic fungi (assemblage, diversity and community structure) (Cooke and Rayner, 1984). Decomposer fungal community in mangroves plays a major role in unlocking energy from the detritus and transfers it into the higher trophic levels (Wafar *et al*., 1997). Woody litter is one of the long-lasting resources in mangroves and provides niches for saprophytic fungi and fauna for sustained activity for extended periods. Mangrove woody litter constitutes the second important host after marine driftwood for fungal colonization (Hyde *et al*., 2000). Assessment of structural (e.g. assemblage, diversity and co-occurrence) and functional (e.g. decomposition, extracellular enzymes and respiration) profiles will be immensely valuable in assessment of ecosystem functions or fungal saprophytism. Although several studies are available on the diversity and activity of saprophytic fungi on woody litter in mangroves of east coast and west coast of India (e.g. Borse, 1988; Sarma and Vittal, 2000, 2001; Maria and Sridhar, 2003, 2004; Ananda and Sridhar, 2004), a few studies have addressed the co-occurrence (e.g. Sridhar and Maria, 2006; Sarma and Raghukumar, 2013). Thus, the main aim of this study is to document fungal assemblage and co-occurrence on woody litter (natural and introduced) of one of the dominant mangrove tree species *Avicennia officinalis* during two seasons (monsoon and summer) in a southwestern mangrove.

MATERIALS AND METHODS

Woody litter: *Avicennia officinalis* (*Acanthaceae*) is one of the dominant tree species in Nethravathi mangroves of the southwest coast of India (12º50'N, 74º50'E). Nethravathi mangrove show humid climate during June-November (monsoon) and dry climate during December-May. Naturally deposited trapped 150 woody litters of *A. officinalis* were sampled during wet season (October, 2014) and dry season (April, 2015). Easily breakable dried twigs of *A. officinalis* of uniform diameter (1.5 cm) were collected during February 2015, cut into segments (15 cm), sun-dried and preserved in polythene bags until submersion. In each nylon mesh bags (25 10 cm; mesh size, 1 mm), five wood pieces were inserted and 25 bags were randomly introduced in different locations by tying to roots at mid-tide level on the onset of monsoon up to four months (June-September, 2014) and in summer for four months (December, 2014-March, 2015). The introduced woody litters were sampled during wet and dry seasons (October, 2014 and April 2015, respectively). Similar to introduced wood, naturally submerged wood were collected during monsoon and summer were cut into desired size prior to incubation. Within eight hr of sampling, randomly assorted 100 each of natural and introduced woody litter were incubated (25±2ºC) individually on sterile sand bath consisting dilute seawater (17‰) in sterile polythene bags. The incubated woody litters were screened for occurrence of fungal structures at fortnightly intervals up to four months. On each observation, the sand bath was rewetted with sterile distilled water. The fungi observed were identified using taxonomic descriptions (e.g. Hyde and Sarma, 2000; Sarma and Hyde, 2000; Jones *et al*., 2009).

Data analysis: Colonization frequency (CF%) of each fungus on natural and submerged woody litter during monsoon and summer seasons were assessed [CF% = (Number of wood colonized by a specific fungus/Total number of wood supporting sporulating fungi) 100]. Shannon's diversity (Magurran, 1988) and Pielou's equitability (Pielou, 1975) of fungi colonized on woody litter were also assessed.

RESULTS

Colonization and diversity: Natural woody litter consists of 57 species encompassing 31 teleomorphs and 26 anamorphs (**Table 1**). Higher number of fungi (teleomorphs and anamorphs) was found during monsoon (47 spp.) than summer season (21 spp.). Among the core-group fungi (>10%), 12 species were found in monsoon and seven species in summer (3 were core-group in both seasons).

Submerged wood consists of 34 species encompassing 19 teleomorphs and 15 anamorphs (**Table 1**). Monsoon sampled submerged wood consists of higher fungi (17 spp.) than summer (13 spp.). Eight core-group fungi were found in monsoon, while seven fungi in summer (6 were core-group in both seasons). Eight species (*Aniptodera* sp., *Lignincola laevis, Lulworthia grandispora, Savoryella lignicola, S. paucispora, Tirispora* sp., *Tricladium linderi* and *Zalerion varia*) were common to natural and submerged wood in both seasons.

Table 1. Colonization frequency (%) of fungi on *Avicennia officinalis* woody litter (-, not occurred; *, core-group fungi at least on any woody litter or season).

Taxon	Natural wood		Submerged wood	
	Monsoon	Summer	Monsoon	Summer
Ascomycetes				
**Aigialus mangroveis* Borse	-	-	6	13
Aniptodera chesapeakensis Shearer & M.A. Mill.	1	-	-	-
A. mangrovei K.D. Hyde	2	2	2	-
Aniptodera sp	1	2	8	6
Caryosporella rhizophorae Kohlm.	1	-	-	-
C. maritima Werderm.	-	-	-	1
Cumulospora sp.	-	-	1	-
Dactylospora haliotrepha (Kohlm. & E. Kohlm.) Hafellner	-	1	-	-
Didymella avicenniae S.D. Patil & Borse	-	1	-	-
Durella sp.	1	-	-	-
Eutypa bathurstensis K.D. Hyde & Rappaz	1	-	-	-
Halosarpheia cincinnatula Shearer & J.L. Crane	-	1	4	7
H. fibrosa Kohlm. & E. Kohlm.	2	-	-	-
H. fibrosa Kohlm. & E. Kohlm.	7	-	-	-
Kallichroma tethys (Kohlm.) Kohlm. & Volkm. Kohlm.	2	-	-	-
Leptosphaeria australiensis (Cribb & J.W. Cribb) G.C. Hughes	-	2	-	-
**Lignincola laevis* Höhnk	17	84	28	22
L. longirostris (Cribb & J.W. Cribb) Kohlm.	-	-	4	-
**L. tropica* Kohlm.	11	-	5	-
**Lulworthia grandispora* Meyers	7	37	3	2
**Lulworthia* sp.	-	8	39	49
**Passeriniella mangrovei* G.L. Maria & K.R. Sridhar	42	-	8	3
Saagaromyces ratnagiriensis (S.D. patil & Borse) K.L. Pang & E.B.G. Jones	3	-	-	-
**Savoryella lignicola* E.B.G. Jones & R.A, Eaton	19	10	5	4
S. longispora E.B.G. Jones & K.D. Hyde	3	3	-	-
**S. paucispora* (Cribb & J.W. Cribb) J. Koch	28	26	17	3
Sporoschima sp.	-	-	4	-
Tirispora mandoviana V.V. Sarma & K.D. Hyde	-	-	-	2
**Tirispora* sp.	4	23	33	38
**Verruculina enalia* (Kohlm.) Kohlm. & Volkm. Kohlm.	4	-	14	17
Zignoëlla sp.	1	-	-	-
Zopfiella latipes (N. Lundq.) Malloch & Cain	1	-	1	-
*Ascomycete sp. 1	29	-	-	-
Ascomycete sp. 2	2	-	-	-
Ascomycete sp. 3	1	-	-	-
Ascomycete sp. 4	-	8	-	-
Basidiomycete				
Auricularia sp.	1	-	-	-
Anamorphs				
Acremonium sp.	3	-	6	-
Alternaria sp. 1	3	-	6	1
Alternaria sp. 2	1	-	-	-
Brachysporiella gayana Bat.	1	-	-	-
Cirrenalia macrocephala (Kohlm.) Meyers & R.T. Moore	1	-	-	-
**Cirrenalia pygmea* Kohlm.	-	27	15	22
**C. tropicalis* Kohlm.	-	6	19	15
Dactylella sp.	1	-	-	-
Diplocladiella scalaroides G. Arnuad	3	-	-	-
Graphium sp.	3	-	-	-
Helicomyces roseus Link	1	-	-	-
**Monodictys putredinis* (Wallr.) S. Hughes	10	-	2	-
Monodictys sp.	-	-	1	-
Penicillium sp.	2	-	2	-
Periconia prolifica Anastasiou	1	-	2	1
**Phaeoisaria clematidis* (Fuckel) S. Hughes	17	-	-	-
**Phoma* sp.	24	-	-	-
Sporidesmium sp.	1	-	-	-
**Trichocladium achrasporum* (Meyers & R.T. Moore) M. Dixon	12	1	20	6
T. achrasporum (Meyers & R.T. Moore) M. Dixon	4	-	3	1
T. alopallonellum (Meyers & R.T. Meyers) Kohlm. & Voklm.-Kohlm.	4	-	-	-
**T. linderi* J.L. Crane & Shearer	42	2	7	1
Trichocladium sp.	-	-	2	-
Verticillium sp.	3	-	-	-
**Zalerion maritima* (Linder) Anastasiou	13	-	8	6
**Z. varia* Anastasiou	5	34	8	1
Anamorph sp. 1	-	2	-	-
Anamorph sp. 2	-	3	3	-
Total teleomorphs	25	14	17	13
Total anamorphs	22	7	15	9
Total species	47	21	32	22
Total core-group species (≥10%)	12	7	8	7

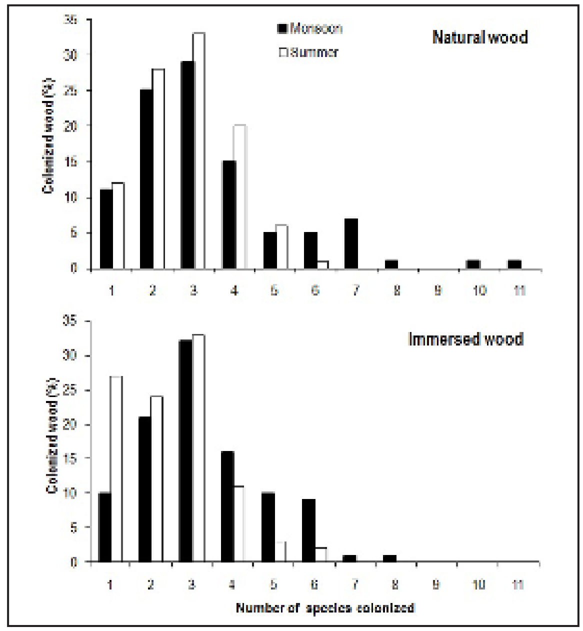

Fig. 1. Per cent woody litter (natural and submerged) of *Avicennia officinalis* colonized by single and co-occurrence of filamentous fungi in Nethravathi mangrove.

Shannon diversity of colonized fungi was the highest in natural wood in monsoon (4.542) followed by submerged wood in monsoon (4.351), submerged wood in summer (3.559) and natural wood in summer (3.291). The Pielou's equitability was highest in monsoon samples of submerged wood (0.870) followed by natural wood in monsoon (0.818), submerged wood in summer (0.798) and natural wood in summer 0.749).

Co-occurrence: Occurrence of single species on natural wood was ranged from 11-12%, while it was 10-27% in submerged wood (**Fig. 1**). Number of co-occurrences of species per wood was extended up to 11 and 8 species during monsoon in natural and submerged wood, respectively. In both wood types during summer, the maximum number co-occurrences of species per wood was only six species. In natural as well as submerged wood, co-occurrences of three species were the highest in both seasons. As seen in overall colonization (**Table 1**), the three species co-occurrences in natural wood were higher (teleomorphs, anamorphs and core-group species) than submerged wood, so also during monsoon than summer (**Table 2**).

On comparison of co-occurrences (%) of 20 core-group species, dominance was seen in natural than in submerged wood, so also during monsoon than summer (**Table 3**). Co-occurrence of core-group fungi was ranged from 3% (*Aigialus mangroveis* in submerged wood during summer) to 72% (*Lignincola laevis* in natural wood during summer). Single species occurrence of core-group fungi on wood was as low as 0% (in many species) and raised up to 12% (*Lignincola laevis* in natural wood during summer).

Table 2. Colonization frequency (%) three species co-occurrence of fungi on *Avicennia officinalis* woody litter (-, not occurred).

Taxon	Natural wood		Immersed wood	
	Monsoon	Summer	Monsoon	Summer
Ascomycetes				
Aigialus mangroveis Borse	-	-	2	1
Aniptodera mangrovei K.D. Hyde	-	-	1	-
Aniptodera sp.	-	-	2	4
Caryosporella rhizophorae Kohlm.	1	-	-	-
Halosarpheia cincinnatula Shearer & J.L. Crane	-	1	1	6
H. fibrosa Kohlm. & E. Kohlm.	4	-	-	-
Lignincola laevis Höhnk	4	24	12	11
L. longirostris (Cribb & J.W. Cribb) Kohlm.	-	-	1	-
L. tropica Kohlm.	2	-	-	-
Lulworthia grandispora Meyers	-	14	1	1
Lulworthia sp.	-	3	13	23
Passeriniella mangrovei G.L. Maria & K.R. Sridhar	14	-	2	1
Savoryella lignicola E.B.G. Jones & R.A. Eaton	5	4	2	2
S. longispora E.B.G. Jones & K.D. Hyde	2	3	-	-
S. paucispora (Cribb & J.W. Cribb) J. Koch	6	11	6	2
Sporoschima sp.	-	-	2	-
Tirispora mandoviana V.V. Sarma & K.D. Hyde	-	-	-	2
Tirispora sp.	4	11	13	18
Verruculina enalia (Kohlm.) Kohlm. & Volkm. Kohlm.	-	-	4	6
Ascomycete sp. 1	7	-	1	-
Ascomycete sp. 2	1	-	-	-
Ascomycete sp. 3	-	1	-	-
Ascomycete sp. 4	-	5	-	-
Anamorphs				
Acremonium sp.	2	-	-	-
Alternaria sp. 1	1	-	-	-
Cirrenalia pygmea Kohlm.	-	7	7	11
C. tropicalis Kohlm.	-	2	7	8
Diplocladiella scalaroides G. Arnuad	2	-	-	-
Graphium sp.	2	-	-	-
Monodictys putredinis (Wallr.) S. Hughes	5	-	-	-
Penicillium sp.	1	-	-	-
Periconia prolifica Anastasiou	-	-	1	-
Phaeoisaria clematidis (Fuckel) S. Hughes	1	-	-	-
Phoma sp.	8	-	-	-
Sporidesmium sp.	1	-	-	-
Trichocladium achrasporum (Meyers & R.T. Moore) M. Dixon	5	-	7	2
T. alopallonellum (Meyers & R.T. Meyers) Kohlm. & Voklm.-Kohlm.	1	-	-	-
T. linderi J.L. Crane & Shearer	16	1	4	1
Trichocladium sp.	-	-	1	-
Verticillium sp.	2	-	-	-
Zalerion maritima (Linder) Anastasiou	2	-	2	2
Z. varia Anastasiou	1	12	2	1
Anamorph sp. 1	-	-	1	-
Anamorph sp. 2	-	-	1	-
Total teleomorphs	11	10	15	12
Total anamorphs	15	4	10	6
Total species	26	14	25	18
Total core-group species (≥10%)	2	5	3	4

Table 3. Comparison frequency (%) of co-occurrence of core-group fungi on *Avicennia officinalis* woody litter (within bracket, % wood colonized by only this species; -, not occurred; *, occurrence <10%: see Table 1).

Taxon	Natural wood		Submerged wood	
	Monsoon	Summer	Monsoon	Summer
Ascomycetes				
Aigialus mangroveis Borse	-	-	*	3 (8)
Lignincola laevis Höhnk	16 (1)	72 (12)	28 (1)	22 (0)
L. tropica Kohlm.	10 (0)	-	*	-
Lulworthia grandispora Meyers	*	36 (0)	*	*
Lulworthia sp.	-	*	38 (2)	48 (6)
Passeriniella mangrovei G.L. Maria & K.R. Sridhar	32 (6)	-	*	*
Savoryella lignicola E.B.G. Jones & R.A, Eaton	14 (0)	*	*	*
S. paucispora (Cribb & J.W. Cribb) J. Koch	28 (0)	18 (0)	17 (0)	*
Tirispora sp.	*	24 (0)	33(1)	36 (6)
Verruculina enalia (Kohlm.) Kohlm. & Volkm. Kohlm.	*	-	12 (2)	16 (3)
Ascomycete sp. 1	21 (0)	-	-	-
Anamorphs				
Cirrenalia pygmea Kohlm.	-	26 (0)	15 (0)	22 (1)
C. tropicalis Kohlm.	-	*	19 (0)	14 (0)
Monodictys putredinis (Wallr.) S. Hughes	9 (0)	-	*	-
Phaeoisaria clematidis (Fuckel) S. Hughes	12 (0)	-	-	-
Phoma sp.	21 (0)	-	-	-
Trichocladium achrasporum (Meyers & R.T. Moore) M. Dixon	12 (0)	*	20 (0)	*
T. linderi J.L. Crane & Shearer	38 (4)	*	*	*
Zalerion maritima (Linder) Anastasiou	12 (0)	-	*	*
Z. varia Anastasiou	*	27 (0)	*	*

A few examples of high co-occurrence in our study includes 11 fungi on one natural wood in monsoon (*Halosarpheia fibosa, Lignincola laevis, Lulworthia grandispora, Monodictys putredinis, Phaeoisaria clematidis, Saagaromyces ratnagiriensis, Savoryella paucispora, S. lignicola, Trichocladium linderi, Verruculina enalia* and *Zalerion maritima*); 10 fungi on one natural wood in monsoon (Ascomycete sp. 1, *Kallichroma tethys, Lignincola tropica, Lulworthia grandispora, Monodictys putredinis, Periconia prolifica, Phaeoisaria clematidis, Savoryella paucispora, Trichocladium achrasporum* and *T. linderi*); eight fungi on one natural wood in monsoon (*Aniptodera mangrovei*, Ascomycete sp. 1, *Lignincola laevis, Lulworthia grandispora, Savoryella lignicola*, *S. paucispora, Trichocladium linderi* and *Zalerion maritima*). In these three combinations (11, 10 and 8 fungi) *L. grandispora*, *S. paucispora* and *T. linderi* were common. Similarly, eight species co-occurrence in one submerged wood include *Aniptodera* sp., *Halosarpheia cincinnatula, Lignincola tropica, Lulworthia* sp., *Penicillium* sp., *Savoryella lignicola, Tirispora* sp., and *Trichocladium achrasporum*.

DISCUSSION

Colonization and diversity: Colonization and diversity of marine fungi are influenced by various biotic (e.g. nature of wood, extent of decay and fungal competition) and abiotic (e.g. duration of submersion and water chemistry) factors, where substrata play a significant role (Nakagiri, 1993; Hyde and Lee, 1995; Jones, 2000). The present study revealed variations in the pattern of fungal colonization, diversity and co-occurrence on woody litter of *Avicennia officinalis* as seen in earlier studies on woody litter of *Rhizophora mucronata* (Sridhar and Maria, 2006; Sarma and Raghukumar, 2013). Compared to *Rhizophora* wood, the overall fungal richness in *Avicennia* wood in mangroves was lower (e.g. Sarma and Vittal, 2000; Maria and Sridhar, 2003, 2004; Sridhar and Maria, 2006; Sarma and Raghukumar, 2013).

The dominance of fungi on woody litter in mangroves is dependent on the mangrove ecosystem. For instance, fungi those are dominant on wood in mangroves of Gujarat, Maharashtra and Goa were different than those found in the mangroves of Karnataka and Kerala (Maria and Sridhar, 2002, 2003, 2004; Sridhar and Maria, 2006; Sarma and Raghukumar, 2013; Sridhar 2013). Although some studies are available on the colonization and diversity of fungi on woody litter in mangroves of the Indian coast, comparative accounts between east coast and west coast are lacking.

As seen in the present study, naturally submerged wood of *Rhizophora mucronata* possess higher fungal occurrence than artificially submerged wood in mangroves (Sridhar and Maria, 2006). The dominance of fungi on mangrove wood will be more during monsoon than summer (Maria and Sridhar, 2003; Sridhar and Maria, 2006). The terrestrial fungi were dominant in overall occurrence during monsoon season likely owing to lower salinity than summer season. Considerable number of terrestrial fungi was also seen during monsoon in three species co-occurrences (see **Table 2**). Terrestrial fungi were not the members of core-group in natural as well as submerged wood (see **Table 3**). However, the role of terrestrial fungi in mangroves during monsoon season cannot be ignored as they depend on ruderal strategy for colonization on substrata and dissemination.

In our study, the Shannon diversity was highest in monsoon than summer irrespective of natural and submerged wood of *A. officinalis*. The results were also similar in natural and submerged wood of *R. mucronata* in Nethravathi mangrove (Sridhar and Maria, 2006). The diversity on five types of naturally submerged mangrove woody litter also represented the higher diversity during monsoon than summer season (Maria and Sridhar, 2003), so also on deliberately submerged *Avicennia officinalis* as well as *Rhizophora mucronata* woody litter in the Udyavara mangrove of southwestern India (Maria and Sridhar, 2004). The fungal diversity was also higher during the monsoon season than summer season on naturally occurring woody litter in Nethravathi and Udyavara mangroves (Ananda and Sridhar, 2004).

Co-occurrence: The co-occurrence of fungi on woody litter in our study was extended up to 11 species on *Avicennia officinalis*, but co-occurrence was only up to 5-9 species in *Rhizophora mucronata* (Sridhar and Maria, 2006; Sarma and Raghukumar, 2013). On natural *R. mucronata* wood, two species dominance was predominant (21-40%) (Sridhar and Maria, 2006; Sarma and Raghukumar, 2013). In submerged *R. mucronata* wood, during monsoon three species co-occurrence was the highest (22%), while during summer two species co-occurrence was the highest (38%) (Sridhar and Maria, 2006). The impact of saprophytic fungi on wood in mangroves is largely influenced by co-occurrences or consortia rather than single species occurrence on woody litter (Sridhar and Maria, 2006; Sarma and Raghukumar, 2013). However, *Rimora mangrovei* occurred singly in 100% of *Rhizophora mucronata* wood which deserves further study. Based on co-culturing, Tan *et al*. (1995) demonstrated that *Lignincola laevis* and *Verruculina enalia* are inhibitory to each other. Miller *et al*. (1985) considered *Lulworthia* sp. as an aggressive fungus against other fungi. All these fungi on *Avicennia* wood were core-group fungi in our study. However, *Lignincola laevis* dominated on natural as well as submerged wood in both seasons (monsoon and summer), while *Lulworthia* sp. and *Verruculina enalia* were dominant only on submerged wood. Their co-occurrence on wood ranged between 12 and 72%, while single species occurrence ranged from 2-12%, indicating that they cope up at various degrees with associated fungi during wood decomposition. Unlike dominance of *Lignincola laevis* on *Avicennia officinalis* wood (natural as well as submerged), *Lulworthia grandispora* was dominant on *R. mucronata* wood (Sridhar and Maria, 2006). Three core-group fungi (*Lulworthia grandispora, Lignincola laevis* and *Verruculina enalia*) coexisted with several fungi on woody litter in mangrove ecosystem (Ananda and Sridhar, 2004). Interestingly, *V. enalia* showed 100% co-occurrence on *Rhizophora mucronata* wood in Chorao mangroves of Goa, while *Rimora mangrovei* showed 100% single species occurrence (Sarma and Raghukumar, 2013).

In our study, *Cirrenalia tropicalis*, *Lulworthia* sp. and *Verruculina enalia* were dominant (or core-group) only on submerged wood (see **Table 3**) which shows their capability to colonize freshly submerged wood successfully. Among 20 core-group fungi, 16 species (in natural/submerged wood and or monsoon/summer) did not occurred as single species which denotes that they support co-occurrences. However, *Aigialus mangroveis*, *Lulworthia* sp., *Verruculina enalia* showed single species occurrence on wood ranging from 2-8% and such independent occurrence needs further study.

CONCLUSIONS

Saprophytic fungi are largely co-occurring to exploit the detritus resource. However, dominance of single species or a group of species or consortia cannot be ruled out. The present study forecasted that the extent of colonization of filamentous fungi on woody litter of *Avicennia officinalis* is next to *Rhizophora mucronata*. In addition to typical marine fungi, several terrestrial fungi colonized the woody litter as demonstrated by earlier studies. *Aniptodera* sp., *Lignincola laevis, Lulworthia grandispora, Savoryella lignicola, S. paucispora, Tricladium linderi*, *Tirispora* sp. and *Zalerion varia* were common to natural and submerged wood in monsoon and summer seasons. The diversity was higher during monsoon than summer irrespective of type of wood corroborating the earlier findings. The co-occurrence of fungi per wood was as high as 11 species during monsoon on naturally submerged wood. The three fungal co-occurrences was highest in natural as well as introduced wood during both seasons. *Lignincola laevis* co-occurred up to a maximum of 72% on natural wood during summer which reflects its compatibility or accommodating ability with associated fungi. Several questions seem to be pertinent on fungal co-occurrences or consortia on a substrate: I) Do they accommodate any fungi ? II) Are they tolerant/antagonistic/selectively inhibitory to each other ? III) Can they function synergistically in resource exploitation? IV) Do they follow successional pattern to exploit the resource? Conventional studies as well as precise molecular approaches provide further insight on colonization and co-occurrences of filamentous fungi on woody litter in mangrove ecosystems.

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