

## MICROFUNGI ASSOCIATED WITH LEAF LITTER DECOMPOSITION OF *MICHELIA NILAGIRICA* AND *SEMECARPUS CORIACEA* AT HAKGALA MONTANE FOREST

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**Abstract:** In Hakgala forest, *Michelia nilagirica* Zenk. and *Semecarpus coriacea* Thw. are two of the major leaf litter contributors to the forest floor. *Michelia nilagirica* leaves require about 2.4 years for 99% decomposition. In contrast, *Semecarpus coriacea* leaves require more than 20 years to complete its decomposition. Since fungi are the main biotic components which regulate the decomposition rates of leaf litter, studies on the fungal communities in both leaf litter types at various decomposition stages are of importance.

Leaves in the freshly fallen, first, second and third decomposition stages of both species were collected using the litter bag technique. Fungi were isolated from leaf material of both types using washing and plating method and the identifications were carried out using identification keys. Common as well as different fungal species were isolated from both leaf materials. *Broomella acuta*, *Cladosporium cladosporioides*, *Trichoderma viride*, *Pseudobotrytis terrestris*, *Curvularia lunata*, *Cylindrocarpum didymum*, *Mortierella vinaceae* and *Nectria coccinea* were the fungal species isolated in the highest frequencies. *B. acuta* and *C. cladosporioides* were present throughout the decomposition process of both types of leaf litter. *Aspergillus* and *Penicillium* species were only occasionally isolated. Hence, the present study provides an account of the fungal species associated with the decomposition of leaf litter of Hakgala montane forest.

**Key words:** decomposition, fungi, leaf litter

### INTRODUCTION

Hakgala strict natural reserve is an upper montane rain forest in the Nuwara Eliya District. The lower elevation of this forest has 97 tree species (over 15 cm GBH) of which 62 are endemic.<sup>3</sup> Some of the common tree species are *Syzygium revolutum* (Wight.) Walp. (Myrtaceae), *Psychotria bisulcata* Wight. & Arn. (Rubiaceae), *Allophylus varians* (Thw.) Redlk. (Sapindaceae), *Michelia nilagirica* Zenk. (Magnoliaceae), *Memecylon parvifolium* Thw. (Melastomataceae), *Eugenia mabaeoides* Wight. (Myrtaceae), *Syzygium rotundifolium* Arn. (Myrtaceae), *Cinnamomum ovalifolium* Wight. (Lauraceae) and *Semecarpus coriacea* Thw. (Anacardiaceae).<sup>1</sup>

In forest ecosystems the annual leaf litter is a major contributor to the nutrient cycling pathway in which a major proportion of the nutrients in the net primary production is returned to the forest floor.<sup>2</sup> The Hakgala forest floor receives a large amount of woody and non-woody litter from various tree species including those mentioned above. The maximum total litter fall (33%) was recorded to be in the June- July period and the minimum (8%) was in the December - January period. The mean total litter fall for the forest floor per year was 7.76 t ha<sup>-1</sup>y<sup>-1</sup> of which 80.5% was represented by non -woody materials.<sup>3</sup>

*M. nilagirica* and *S. coriacea* are two major leaf litter contributors to the forest floor which take first and third place respectively. The decomposition ( $t_{0.99}$ ) of the fallen dead leaves of *M. nilagirica* occurs within 2.4 years whereas decomposition of the fallen dead leaves of *S. coriacea* occurs within a period estimated to be 20.3 years.

Decomposition rates of various substrates are regulated mainly by abiotic (climate) and biotic (substrate quality, micro-organisms and soil fauna) factors.<sup>4,5,6</sup> Climatic or abiotic factors such as rainfall, temperature and humidity are not helpful in predicting the different decomposition rates of the various types of leaf litter at the Hakgala forest. This is because these various types of litter occur together in the forest floor where differences in moisture and temperature regimes are not significant. Therefore the causative factors for the differences in the decomposition rates between *M. nilagirica* and *S. coriacea* leaf litter are the biotic factors such as substrate quality, bacteria, fungi and soil fauna.

Fungi are the most important decomposers of plant material and 75% of the

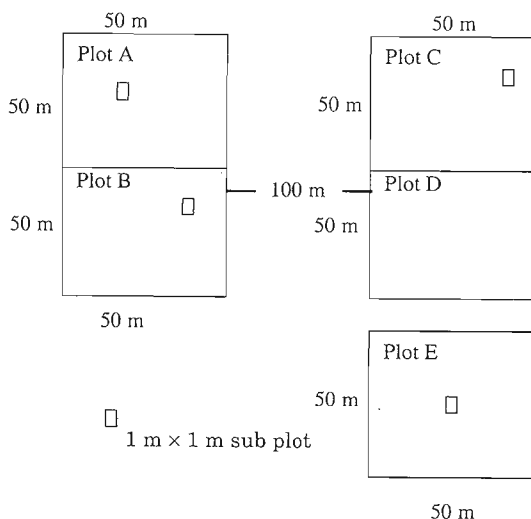
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decomposition of various organic substrates are done mainly by different fungal species.<sup>7</sup> No single fungal species is able to use all components of a substrate and it is well established that a succession of different groups of fungi will appear on different substrates.<sup>8</sup> Since fungi play a major role in litter decomposition, a comparative study on the succession of fungi on the leaf litter of *M. nilagirica* and *S. coriacea* at various decomposition stages was carried out. There have been only a few recorded studies on the fungal succession on leaf litter in Sri Lanka. This investigation has provided an account of different fungal species (communities) involved in leaf litter decomposition in a Sri Lankan montane forest as well as their changes during the decomposition gradient.

## METHODS AND MATERIALS

**Study plots:** At the lower elevation (c.1750) of Hakgala forest five study plots (50 × 50 m) were located in order to represent five replicate samples. Of these, four plots were set up in pairs with a gap of 100 m between the pairs and the fifth plot was set up at an elevation 10 m below one of the pairs of plots. For the placement of litter bags a random 1 m × 1 m sub plot was marked on the forest floor in each of the five study plots (Figure 1).

**Selection of the leaf litter decomposition stages:** To carry out the investigation on fungi associated with the decomposition of selected leaf types it



**Figure 1: Layout of the sampling plots**

was necessary to select analogous litter decomposition stages of both leaf types *M. nilagirica* and *S. coriacea*. This was easy with respect to the leaf litter of *Michelia* because of the rapid decay rate (99% decomposition occurring within 2.4 years). The selection of the decay stages for *Semecarpus* leaf litter posed a problem because of the slow rate of decomposition (99% decomposition in 20.3 years).<sup>3</sup> Therefore the following procedure was used for the two types of leaf litter.

Freshly fallen leaves of the two species were initially collected separately in large nets set up under the trees at each of the five study plots. They were then placed in large sterile polythene bags and transported to the University of Kelaniya. The following procedure was then followed.

**For *M. nilagirica*:** The freshly fallen leaves were placed in nylon mesh bags (mesh size 2 mm, 6 leaves per bag). The bags were taken to the field and placed randomly in each of the five 1 m × 1 m sub plots. Thereafter these bags (2 bags from each sub plot) were sampled 3, 6 and 9 months after placement in the field representing the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> decomposition stages respectively. At each sampling time careful, detailed visual observations were made of the decomposing leaves and descriptions of colour, texture and condition were recorded. Mass remaining (%) was also calculated by drying the litter material in an oven at 80 °C to a constant mass.

**For *S. coriacea*:** Using the visual observations made for each decomposition stages of *Michelia* leaves, the analogous stages of *Semecarpus* leaf litter were selected from the forest floor of each of the five study plots.

Preliminary studies on the morphology and mass remainings (dry wt.) of the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> decomposition stages of both leaf types proved that the analogous decomposition stages of both leaf types were similar.

**Isolation of fungi:** Using five replicate samples from each of the four decomposition stages (freshly fallen, 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup>) of both leaf types, fungal isolations were carried out according to the washing and plating method.<sup>9</sup>

Twelve leaf disks (5 mm diameter) were obtained randomly using 4 leaves of each type (3 disks from each leaf) from each of the 5 replicate samples with the help of a sterilized cork borer. They were then transferred into sterilized screw capped bottles (100 ml capacity) containing 25 ml sterilized distilled water and shaken at 300 revolutions/min for 2 min. This washing process was repeated 20 times using 25 ml portions of sterilized distilled water for each washing. It was determined that 20 repeated washings were required for the efficient removal of surface contaminants associated with leaf material of both plant species.<sup>10</sup> The excess water was then removed from the disks by blotting with sterile filter papers.

Two (1 mm) pieces of leaf were then taken from each disk using a sterilized scalpel (total of 24 1 mm leaf particles from each of the five replicate samples). Leaf particles were then plated (one particle per plate) on 2% malt extract agar supplemented with 0.01% streptomycin sulphate. The plates containing leaf particles were incubated at room temperature (30 °C) for 7-10 d. Using a dissecting microscope (Olympus, 313368) fungi growing from the leaf particles were isolated into pure cultures using the same medium (2% MEA) without antibiotics. Using the sticky tape method<sup>11</sup> and by preparing slide cultures the isolated fungal species were identified using fungal identification keys.<sup>12,13</sup> To identify the fungi which did not sporulate under the given conditions, they were kept under UV light for 1,3,6 and 12 h to activate their sporulating abilities. The identification of these fungal spp. were confirmed by comparing with reference cultures available at the Department of Biological Sciences, University of Calgary, Canada.

### Calculations

Percentage frequencies of isolation of each fungal species were calculated as follows:

$$\% \text{ frequency of isolation} = \frac{\text{No. of particles colonized}}{\text{Total No. of particles plated}} \times 100$$

## RESULTS

As indicated in Appendix 1, the highest frequency of isolation (21.7%) was with *Acremonium strictum* and *Trichothecium roseum* from the freshly fallen leaves of *M. nilagirica*. *N. coccinea* and *Broomella acuta* were isolated in the higher frequencies of 19.17% and 14.17% respectively. *Penicillium variabile* (17.5%), *Broomella acuta* (16.67%), *Cylindrocarpon magnusianum* (12.5%) and *Alternaria tenuissima* (11.67%) were isolated from freshly fallen leaves of *S. coriacea* in higher frequencies. *A. strictum*, *B. acuta*, Dark sterile sp.1, *P. variabile* and *C. magnusianum* were the only fungal species commonly isolated from the freshly fallen stage of both leaf types.

Figure 2 shows the number of fungal spp. isolated from the different decomposition stages of the leaves of *M. nilagirica* and *S. coriacea*. In the case of freshly fallen leaves of both spp. a higher number of fungal spp. were isolated in lower frequencies. e.g. 18 fungal species from *Michelia* and 14 fungal species from *Semecarpus* were isolated in percentage frequencies of 0-4% whereas 4 and 9 fungal spp., respectively from *Michelia* and *Semecarpus* freshly fallen leaves, were isolated in 4.1-16% frequencies. Three fungal spp. from *Michelia* and 2 fungal spp. from *Semecarpus* leaves were isolated in 16.1-64% frequencies. No fungal species were isolated from either spp. in a percentage frequency greater than 64%.

Among the fungi isolated from the 1<sup>st</sup> decomposition stage of *M. nilagirica*, *B. acuta* was isolated in the highest frequency of (36.67%). *Trichoderma viride*, *Cladosporium sphaerospermum*, *Trichoderma pseudokoningii* and Hyaline sterile sp.16 were also isolated in the higher frequencies of 25.83%, 18.33%, 17.5% and 16.67% respectively. *B. acuta* was isolated in the highest frequency (44.17%) from the 1<sup>st</sup> decomposition stage of *Semecarpus*. The other fungal spp. isolated in higher frequencies from *S. coriacea* were *Mortierella vinacea* (16.67%), *Fusarium* sp. 3 (12.5%), Hyaline sterile sp.21 (12.5%), *Nodulosporium* sp. 2 (10.83%) and *Cladosporium cladosporioides* (10.83%). *B. acuta* and *T. viride* were the fungal species isolated from both leaf types at the 1<sup>st</sup> decomposition stage (Appendix 1).

The frequency distribution classes of the fungal community in Figure 2 shows that the fungal species from the 1<sup>st</sup> decomposition stage of both leaf types were isolated mostly in the lower frequencies. Seventeen fungal species from *Michelia* and 10 fungal species from *Semecarpus* were isolated in frequencies of 0-4%. 10 and 17 fungal species were isolated from *Michelia* and *Semecarpus* leaf litter respectively in frequencies of 4.1-16%. Only 5 fungal spp. from *Michelia* and 2 fungal species from *Semecarpus* were isolated in the frequencies of 16.1-64%. No fungal spp. were isolated in a mean percentage frequency higher than 64%.

As indicated in Appendix 1, *T. viride* was isolated in the highest percentage frequency (58.83%) from the 2<sup>nd</sup> decomposition stage of *M. nilagirica*. Dark sterile sp. 17 (39.17%), *Curvularia lunata* (33.33%), Dark sterile sp. 15 (28.33%), *Trichoderma harzianum* (27.5%) and *Cladosporium cladosporioides* (25.83%) were the other fungal spp. isolated in higher frequencies from this stage. *B. acuta* was isolated in the highest percentage frequency (57.5%) from the 2<sup>nd</sup> decomposition stage of *S. coriacea* leaf litter whereas *T. viride*, *M. vinacea*, *C. cladosporioides*, *Pseudobotrytis terrestris* and *Trichoderma piluliferum* were also isolated in higher frequencies (35.8%, 25%, 25%, 21.67% and 19.17% respectively). *B. acuta*, *C. cladosporioides*, *N. coccinea*, *T. piluliferum* and *T. viride* were the commonly isolated species from both leaf litter types.

As seen in Figure 2 fungal spp. from the 2<sup>nd</sup> decomposition stage of both leaf types were isolated in lower frequencies as well as higher frequencies. e.g. 9, 12 and 9 fungal spp. from *Michelia* were respectively isolated in frequencies of 0-4%, 4.1-16% and 16.1-64% respectively whereas 3, 5 and 8 fungal spp. were isolated from *Semecarpus* leaf litter in the frequencies of 0-4%, 4.1-16% and 16.1-64% respectively. No fungal spp. were isolated in the frequencies greater than 64% from either leaf type.

From the 3<sup>rd</sup> decomposition stage of *Michelia* leaf litter, *C. cladosporioides* and *T. piluliferum* were isolated in the highest percentage frequencies of 87.49% and 87.5% respectively. *B. acuta* (86.66%), Dark sterile sp.

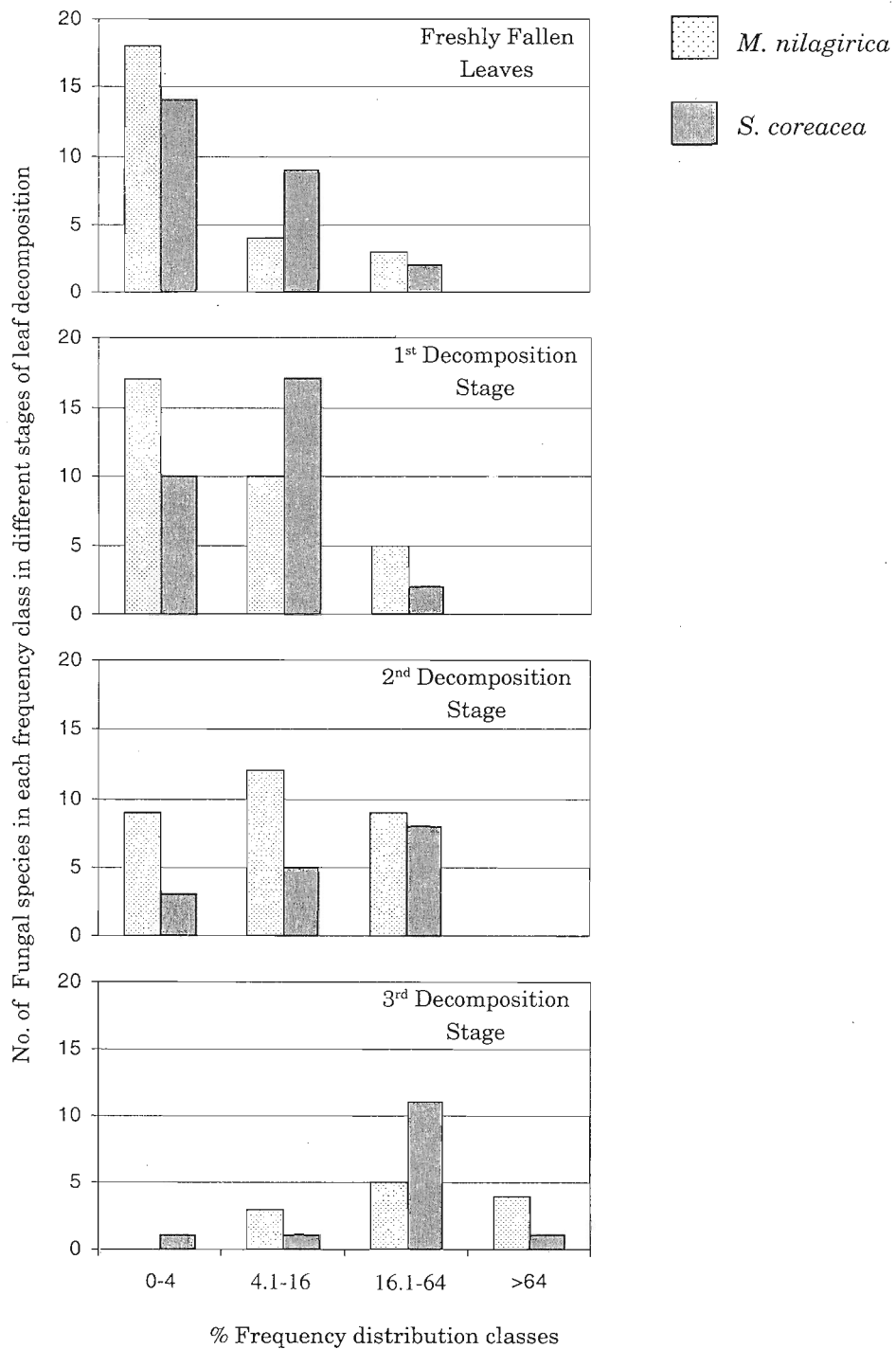
27 (64.17%), *Cylindrocapon didymum* (41.67%), *C. lunata* (37.5%) and *T. viride* (35.83%) were isolated in higher frequencies. From the 3<sup>rd</sup> decomposition stage of *Semecarpus* leaf litter, *T. viride* was isolated in the highest frequency (65%). Hyaline sterile sp. 29, *Rhizopus* sp.1, *Aspergillus* sp.3 and *Trichoderma* sp.1 were the other dominant fungal spp. isolated with the frequencies 60.8%, 57.5%, 50.84% and 49.17% respectively. *T. piluliferum*, *C. cladosporioides*, *B. acuta*, *C. lunata* and *T. viride* were commonly isolated with different frequencies of occurrence from both leaf types. (Appendix 1).

With reference to the frequency distribution classes of the fungal communities shown in the Figure 2, most of the fungal spp. from the 3<sup>rd</sup> decomposition stage of both leaf types were isolated in higher frequencies. No fungal spp. from *Michelia* leaf litter were isolated in the frequency of 0-4% and only 3 fungal spp. were isolated between the frequencies of 4.1-16%. In *Semecarpus* leaf litter only one fungal spp. was isolated in the frequencies 0-4% whereas one was isolated in 4.1-16% frequency. Five and 4 fungal spp. from *Michelia* leaf litter were isolated in the frequencies 16.1-64% and greater than 64% respectively whereas 11 and 1 fungal species from *Semecarpus* leaf litter were isolated respectively in the frequencies of 16.1-64% and greater than 64%.

It was clearly observed that there was an increase of the isolations of fungal species common to both leaf types with the advancement of litter decomposition.

## DISCUSSION

The results obtained for the fungal community structure and its changes during the 4 analogous decomposition stages (freshly fallen, 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup>) of *M. nilagirica* and *S. coriacea* leaf litter indicated the presence of certain fungal species (*A. strictum*, *B. acuta*, Dark sterile sp. 1, *C. cladosporioides*, *N. coccinea*, *T. piluliferum*, *T. viride*.....etc.) that was common to all four stages and other fungal species specific to the four decomposition stages of the two leaf types. Leaf materials of freshly fallen and 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> decomposition stages of both leaf types are present in the L, L<sup>1</sup>, F<sup>1</sup> and F<sup>2</sup> layers respectively of the



**Figure 2: Frequency distribution classes of the fungal community in different stages of leaf decomposition of *Michelia nilagirica* and *Semecarpus coriacea*.**

forest floor materials. Fungal succession on fallen leaves of *Quercus*, *Betula* and *Fraxinus* in a broad leaved UK woodland on mull humus, (until macroscopic leaf structure was lost) has shown differences between the four litter types.<sup>14</sup> The differences between these succession patterns were largely due to the differences in resource

quality such as nitrogen content and the presence of inhibitory tannin concentrations. A comparative study on fungal succession and microbes on leaf litter (*Ageratum conizoides*, *Mallotus philippinensis*, *Holarrhena antidysenterica* and *Vitex glabrata*) in two degraded tropical forests on northeast India has also shown high variations

in the fungal communities in the four litter types.<sup>15</sup> In the present study, the occurrence of different fungal species in *Michelia* and *Semecarpus* leaf litter might be also due to the differences in the leaf quality. The effect of climatic conditions is similar on the fungal spp. active on both types of leaf litter. In the freshly fallen and 1<sup>st</sup> decomposition stages, the occurrence of fungal species common to both leaf types increased during the latter decomposition stages. This could be due to the differences in the structural components in the freshly fallen and slightly decomposed leaves. In later stages of decomposition, the structural components become more or less similar and therefore a higher occurrence of fungal spp. common to both leaf types was observed.

Many of the studies on fungal succession on leaf litter have been carried out in climatic and geographical regions different to those from Sri Lanka. Therefore it is not very appropriate to compare the results obtained in the present study with the observations made from such studies. However the study on the fungal succession on Aspen poplar leaf litter in Kananaskis valley in the front range of rocky mountain in Canada where the mean annual temperature is 4°C, showed the presence of *Aureobasidium pullulans* only on live leaves. Other than this *Cladosporium* spp. including *C. cladosporioides* and *C. sphaerospermum* were observed in the live leaves and litter on the L layer and *Mortierella* spp. were observed in the litter of F layers.<sup>16</sup> Studies on the micro fungi of decomposing red alder leaves in a forest north of Copenhagen showed the occurrence of *Aureobasidium* spp. in the early and middle stages of the decomposition process. *Cladosporium* spp. including *C. cladosporioides* persisted throughout the decomposition process of the Alder leaves. *Mortierella* spp. appeared from the middle of the decomposition process and persisted to the latter decomposition stages.<sup>8</sup> As in the case of these studies, in the present study too *Aureobasidium* spp. were seen only in the early stages (freshly fallen and 1<sup>st</sup> decomposition stage) of *Michelia* leaf litter which are in the L layer of the forest floor materials but were not observed in the fungal succession on *Semecarpus* leaf litter. In the present study too, *Cladosporium* spp. especially *C. cladosporioides* were observed

in several of the decomposition stages of both *Michelia* and *Semecarpus* leaf litter and *Mortierella* sp. (*M. vinacea*) was isolated from the later decomposition stages of *Semecarpus* leaf litter. Although the presence of *Acremonium* spp. was observed throughout the decomposition stages of Aspen leaves<sup>16</sup>, in the present study isolation of *Acremonium* spp. were made only from early decomposition stages of both leaf types.

Fungal succession studies carried out in India, have reported the occurrence of many *Aspergillus* and *Penicillium* spp. throughout the process of decomposition of different plant litter. Isolation of eight *Aspergillus* spp. were reported from the different decomposition stages of *Chenopodium album* leaf litter.<sup>17</sup> Four *Aspergillus* spp. were frequently isolated from decomposing materials of sugar cane bagasses.<sup>18</sup> Three *Aspergillus* spp. and five *Penicillium* spp. were frequently isolated from many of the decomposition stages of *Mallotus* leaf litter. In the decomposing leaves of *Holarrhena antydysentrica* and *Vitex glabrata* leaf litter, *Penicillium chrysogenum* and *Aspergillus niger* were the most dominant fungal spp. occurring during the succession.<sup>15</sup> In the present study the occurrence of *Aspergillus* spp. and *Penicillium* spp. in the decomposing leaves of both types was very low. One *Aspergillus* spp. was isolated in high frequency (50.84%) only from the 3<sup>rd</sup> decomposition stage of *Semecarpus* and only four *Penicillium* spp. were isolated occasionally except for *Penicillium variabile*.

According to the frequency distribution classes of the fungal communities in the four decomposition stages (Figure 2) it was clearly observed that the fungal isolations from the early decomposition stages of both leaf types occurred in lower frequencies. With the advancement of litter decomposition the fungal isolations occurred in higher frequencies from both leaf litter types. The distribution of fungal species present in the freshly fallen leaves and the leaves in decomposition stage 1, of both leaf types may be localized into some areas of the leaves. However in the latter decomposition stages of both leaf types, their distribution may be more or less even over the leaf surface in both leaf types. Therefore, this could be the reason for their isolation in lower

frequencies from the early decomposition stages and isolation in higher frequencies from the latter decomposition stages of both leaf types.

From the present study it is clear that *B. acuta*, *C. cladosporioides*, *C. lunata*, *N. coccinea*, *T. piluliferum* and *T. viride* were the dominant fungal spp. isolated from several decomposition stages of both leaf types with higher frequencies. Among them *B. acuta* was the most dominant fungal spp. isolated from all 4 decomposition stages of both leaf types with higher frequencies. These fungal spp. may have more competitive saprophytic abilities than the other litter inhabiting mycoflora in the Hakgala forest floor and also they may have versatile substrate utilization abilities to utilize many of the labile and non labile complex structural cell wall components.

This study reveals the pattern of succession in fungal communities and gives an insight to the nutrient turnover in the ecosystem. An additional advantage is that the identified fungal cultures isolated during this study could be used as reference cultures. Therefore in addition to maintaining the live cultures, a database could be maintained where all the information on this collection of fungal isolates is available.

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### Appendix 1

Percentage frequency of occurrence of the dominant fungal species at different stages (freshly fallen leaves (fresh stage), decomposition stages 1-3 (1<sup>st</sup>- 3<sup>rd</sup> stages) of *Michelia nilagirica* and *Semecarpus coreacea*, in the Hakgala Strict Natural Reserve.

Dominant fungi in different stages of decomposition	Decomposing leaves of <i>Michelia nilagirica</i>				Decomposing leaves of <i>Semecarpus coreacea</i>			
	Fresh stage	1 <sup>st</sup> stage	2 <sup>nd</sup> stage	3 <sup>rd</sup> stage	Fresh stage	1 <sup>st</sup> stage	2 <sup>nd</sup> stage	3 <sup>rd</sup> stage
<i>Acremonium kilience</i>	2.5	13.33	-	-	-	-	-	-
<i>Acremonium strictum</i>	21.67	-	-	-	7.5	-	-	-
<i>Acremonium butyri</i>	-	-	-	-	1.67	-	-	-
<i>Acremonium</i> sp.2	-	-	-	-	-	2.50	-	-
<i>Alternaria tenuissima</i>	-	2.5	-	-	11.67	-	-	-
<i>Amorphotheca resiniae</i>	-	-	-	-	-	5.0	-	-
<i>Aspergillus</i> sp.1	-	-	0.83	-	-	-	-	-
<i>Aspergillus</i> sp.2	-	-	4.17	-	-	-	-	-
<i>Aspergillus</i> sp.3	-	-	-	-	-	-	-	50.84
<i>Aureobasidium</i> sp.1	0.83	-	-	-	-	-	-	-
<i>Aureobasidium</i> sp.2	-	6.67	-	-	-	-	-	-
Basidiomycete sp.1	5	-	-	-	-	-	-	-
Basidiomycete sp.2	-	-	11.67	-	-	-	-	-
<i>Botrytis cinerea</i>	-	2.5	-	-	-	-	-	-
<i>Broomella acuta</i>	14.17	36.67	17.5	86.66	16.67	44.17	57.5	35.83
<i>Chloridium clamydosporis</i>	-	-	-	-	-	10	-	-
<i>Cladosporium cladosporioides</i>	8.33	-	25.83	87.49	-	10.83	25	46.67
<i>Cladosporium sphaerospermum</i>	-	18.33	-	-	-	-	-	-
<i>Cladosporium</i> sp.1	-	-	-	27.5	-	-	-	-
<i>Cladosporium</i> sp.2	-	-	-	10.83	-	-	-	-
Coelomycete sp.1	0.83	-	-	-	-	-	-	-
Coelomycete sp.2	1.67	-	-	-	-	-	-	-
Coelomycete sp.3	-	-	-	-	5	-	-	-

Dominant fungi in different stages of decomposition	Decomposing leaves of <i>Michelia nilagirica</i>				Decomposing leaves of <i>Semecarpus coreacea</i>			
	Fresh stage	1 <sup>st</sup> stage	2 <sup>nd</sup> stage	3 <sup>rd</sup> stage	Fresh stage	1 <sup>st</sup> stage	2 <sup>nd</sup> stage	3 <sup>rd</sup> stage
Coelomycete sp.4	-	13.33	-	-	-	-	-	-
<i>Curvularia lunata</i>	-	3.33	33.33	37.5	-	-	-	35.83
<i>Cylindrocarpon didymum</i>	-	11.67	-	41.67	-	-	-	-
<i>Cylindrocarpon parvum</i>	-	-	-	-	-	10	-	-
<i>Cylindrocarpon magnusianum</i>	1.67	-	-	-	12.5	-	-	-
<i>Cylindrocarpon</i> sp.1	-	5.83	-	-	-	-	-	-
<i>Cylindrocarpon</i> sp.2	-	-	-	-	-	3.33	-	-
<i>Cylindrocarpon</i> sp.3	-	-	6.66	-	-	0.83	-	-
<i>Cylindrocarpon</i> sp.4	-	-	5	-	-	-	-	-
Dark sterile sp. 1	4.17	-	-	-	5.83	-	-	-
Dark sterile sp. 2	-	-	-	-	8.33	-	-	-
Dark sterile sp. 3	-	-	-	-	2.5	-	-	-
Dark sterile sp. 4	-	-	-	-	2.5	-	-	-
Dark sterile sp. 5	-	-	-	-	0.83	-	-	-
Dark sterile sp. 6	-	-	-	-	2.5	-	-	-
Dark sterile sp. 7	-	-	-	-	1.67	-	-	-
Dark sterile sp. 8	-	-	-	-	10	-	-	-
Dark sterile sp. 9	-	11.67	-	-	-	-	-	-
Dark sterile sp. 10	-	-	-	-	-	1.66	-	-
Dark sterile sp. 11	-	-	-	-	-	4.17	-	-
Dark sterile sp. 12	-	-	-	-	-	6.67	-	-
Dark sterile sp. 13	-	-	-	-	-	10	-	-
Dark sterile sp. 14	-	-	-	-	-	3.33	-	-
Dark sterile sp. 15	-	-	28.33	-	-	-	-	-
Dark sterile sp. 16	-	-	0.83	-	-	-	-	-
Dark sterile sp. 17	-	-	39.17	-	-	-	-	-
Dark sterile sp. 18	-	-	18.33	-	-	-	-	-
Dark sterile sp. 19	-	-	13.33	-	-	-	-	-
Dark sterile sp. 20	-	-	5.83	-	-	-	-	-
Dark sterile sp. 21	-	-	1.67	-	-	-	-	-
Dark sterile sp. 22	-	-	24.17	-	-	-	-	-
Dark sterile sp. 23	-	-	3.33	-	-	-	-	-
Dark sterile sp. 24	-	-	9.17	-	-	-	-	-
Dark sterile sp. 25	-	-	-	-	-	-	9.17	-
Dark sterile sp. 26	-	-	-	-	-	-	25	-
Dark sterile sp. 27	-	-	-	64.17	-	-	-	-
Dark sterile sp. 28	-	-	-	-	-	-	-	38.33
Dark sterile sp. 29	-	-	-	-	-	-	-	45.83
<i>Diheterospora catenulata</i>	3.33	-	-	-	-	-	-	-
<i>Fusarium acuminata</i>	-	-	-	-	0.83	-	-	-
<i>Fusarium sporotrichioides</i>	-	-	-	-	-	5	-	-
<i>Fusarium</i> sp.1	-	-	0.83	-	-	-	-	-
<i>Fusarium</i> sp.2	-	1.67	-	-	-	-	-	-
<i>Fusarium</i> sp.3	-	-	-	-	-	12.5	-	-
<i>Fusarium</i> sp.4	-	-	4.17	-	-	-	-	-
<i>Fusarium</i> sp.5	-	-	3.33	-	-	-	-	-
<i>Fusarium</i> sp.6	-	-	0.83	-	-	-	-	-
<i>Fusarium</i> sp.7	-	-	-	16.67	-	-	-	-
<i>Geotrichum candidum</i>	-	-	-	-	-	5.83	6.67	-

Dominant fungi in different stages of decomposition	Decomposing leaves of <i>Michelia nilagirica</i>				Decomposing leaves of <i>Semecarpus coreacea</i>			
	Fresh stage	1 <sup>st</sup> stage	2 <sup>nd</sup> stage	3 <sup>rd</sup> stage	Fresh stage	1 <sup>st</sup> stage	2 <sup>nd</sup> stage	3 <sup>rd</sup> stage
<i>Gliomastix</i> sp.1	-	-	-	-	-	-	9.17	-
<i>Gliocladium catenulatum</i>	-	3.33	-	-	-	-	-	-
<i>Glomerella cingulata</i>	-	11.67	-	-	8.33	-	-	-
Hyaline sterile sp.1	1.67	-	-	-	-	-	-	-
Hyaline sterile sp.2	1.67	-	-	-	-	-	-	-
Hyaline sterile sp.3	2.5	-	-	-	-	-	-	-
Hyaline sterile sp.4	2.5	-	-	-	-	-	-	-
Hyaline sterile sp.5	1.67	-	-	-	-	-	-	-
Hyaline sterile sp.6	2.5	-	-	-	-	-	-	-
Hyaline sterile sp.7	1.67	-	-	-	-	-	-	-
Hyaline sterile sp.8	2.5	-	-	-	-	-	-	-
Hyaline sterile sp.9	-	-	-	-	1.67	-	-	-
Hyaline sterile sp.10	-	-	-	-	1.67	-	-	-
Hyaline sterile sp.11	-	-	-	-	2.5	-	-	-
Hyaline sterile sp.12	-	-	-	-	0.83	-	-	-
Hyaline sterile sp.14	-	1.67	-	-	-	-	-	-
Hyaline sterile sp.15	-	3.33	-	-	-	-	-	-
Hyaline sterile sp.16	-	16.67	-	-	-	-	-	-
Hyaline sterile sp.17	-	2.5	-	-	-	-	-	-
Hyaline sterile sp.18	-	5	-	-	-	-	-	-
Hyaline sterile sp.19	-	1.67	-	-	-	-	-	-
Hyaline sterile sp.20	-	-	-	-	-	2.5	-	-
Hyaline sterile sp.21	-	-	-	-	-	12.5	-	-
Hyaline sterile sp.22	-	-	-	-	-	15	-	-
Hyaline sterile sp.23	-	-	-	-	-	3.33	-	-
Hyaline sterile sp.24	-	-	-	-	-	3.33	-	-
Hyaline sterile sp.25	-	-	-	-	-	4.17	-	-
Hyaline sterile sp.26	-	-	1.67	-	-	-	-	-
Hyaline sterile sp.27	-	-	1.67	-	-	-	-	-
Hyaline sterile sp.28	-	-	-	14.17	-	-	-	-
Hyaline sterile sp.29	-	-	-	-	-	-	-	60.83
Hyaline sterile sp.30	-	-	-	-	-	-	-	24.1
<i>Mortierella vinacea</i>	-	-	-	-	-	16.67	25	-
<i>Mucor</i> sp.1	-	-	-	-	-	-	-	2.5
<i>Myrothesium</i> sp.1	-	-	-	-	0.83	-	-	-
<i>Nectria coccinea</i>	19.17	12.5	10	-	-	-	5.83	-
<i>Nectria</i> sp.2	-	-	1.67	-	-	-	-	-
<i>Nodulosporium</i> sp.1	-	2.5	-	-	-	-	-	-
<i>Nodulosporium</i> sp.2	-	-	-	-	-	10.83	-	-
<i>Nodulosporium</i> sp.3	-	-	-	-	-	-	3.33	-
<i>Penicillium variabile</i>	3.33	-	-	-	17.5	10	-	-
<i>Penicillium</i> sp.1	-	-	-	-	5	-	-	-
<i>Penicillium</i> sp.2	-	-	-	-	5.83	-	-	-
<i>Penicillium</i> sp.3	-	-	5.83	-	-	-	-	-
<i>Penicillium</i> sp.4	-	-	-	-	-	-	2.5	-
<i>Phialophora</i> sp.1	-	2.5	-	-	-	-	-	-
<i>Phialophora</i> sp.2	-	1.67	-	-	-	-	-	-
<i>Phialophora</i> sp.3	-	2.50	-	-	-	-	-	-
<i>Phialophora</i> sp.4	-	2.5	-	-	-	-	-	-

Dominant fungi in different stages of decomposition	Decomposing leaves of <i>Michelia nilagirica</i>				Decomposing leaves of <i>Semecarpus coreacea</i>			
	Fresh stage	1 <sup>st</sup> stage	2 <sup>nd</sup> stage	3 <sup>rd</sup> stage	Fresh stage	1 <sup>st</sup> stage	2 <sup>nd</sup> stage	3 <sup>rd</sup> stage
<i>Pithomyces</i> sp.1	-	-	-	14.17	-	-	-	-
<i>Pseudobotrytis terrestris</i>	-	-	-	-	-	-	21.67	42.5
<i>Rhizopus</i> sp.1	-	-	-	-	-	-	-	57.5
<i>Scolecobasidium</i> sp.1	2.5	-	-	-	-	-	-	-
<i>Steptonema</i> sp.1	3.33	-	-	-	-	-	-	-
<i>Trichoderma hamatum</i>	-	5	-	-	-	-	10.01	-
<i>Trichoderma harzianum</i>	-	3.33	27.5	-	-	-	-	-
<i>Trichoderma koningii</i>	-	-	-	-	-	3.33	-	-
<i>Trichoderma piluliferum</i>	-	-	6.67	87.5	-	-	19.17	13.33
<i>Trichoderma pseudokoningii</i>	-	17.5	5.83	-	-	-	-	-
<i>Trichoderma viride</i>	-	25.83	55.83	35.83	-	8.33	35.83	65
<i>Trichoderma</i> sp.1	-	-	-	-	-	6.67	-	49.17
<i>Trichothecium roseum</i>	21.67	-	-	-	-	-	-	-
Unidentified sp.1	2.5	-	-	-	-	-	-	-
Unidentified sp.2	-	-	-	-	3.33	-	-	-
Unidentified sp.3	-	-	-	-	-	-	2.5	-
<b>Total number of spp. recorded at each stage</b>	<b>25</b>	<b>30</b>	<b>31</b>	<b>12</b>	<b>25</b>	<b>28</b>	<b>15</b>	<b>14</b>

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