

CHAPTER 2

LITERATURE REVIEW

This chapter discusses the forests of northern Thailand, the fungal diversity in these forests and the hosts studied. Studies on fungal diversity on leaf litter in the world and in Thailand are reviewed. Host and tissue specificity of fungi are discussed. Different methods of studying fungal communities occurring on leaf litter are discussed, and the significance and usefulness of the present study are introduced.

2.1 Introduction

It has been estimated that the total fungal number is 1.5 million, based in part, on the ratio of 1 host plant species to 6 fungal species in a well-studied area of the United Kingdom. Presently only about 80,000 species have been described (Table 1.2). This means that around 5% of the fungi are known and the other 90% are waiting discovery (Hawksworth, 1991; 2001).

2.1.1 Fungal diversity in tropical forests

Studies on fungal diversity in tropical forests have recently received the attention of mycologists, particularly in Thailand since the 1990s (Jones and Hyde, 2004; Desjardin *et al.*, 2004). Many different groups of fungi have been studied, such as saprobic fungi in terrestrial ecosystems (Kodsueb *et al.*, 2004; Thienhirun and Whalley, 2004), phylloplane fungi (Osono and Mori, 2005), dung fungi (Somrithipol, 2004; Bell, 2005), marine and fresh water fungi (Sakayaroj *et al.*, 2004; Sivichai and Boonyene, 2004; Vijaykrishna and Hyde, 2006), insects fungi (Chukanhom and Hatai,

2004; Jones, 2004), and nematode trapping fungi (Li *et al.*, 2005). However, our understanding of fungal diversity is still poor, especially in the tropical forests.

2.1.2 Fungal diversity in temperate forests

Studies on fungal diversity in temperate forests have a longer history in comparison to those in tropical forests. Early studies started in the second half of the 19th century (De Bary, 1866; Patouillard, 1900). Western mycologists from temperate countries have also had a great influence on the development of fungal studies in Thailand (Heim, 1962; Carroll, 1963; Dissing, 1963; Jones and Hyde, 2004).

2.2 Fungi on leaf litter

Leaves are one of the three indispensable structures of a tree. The annually fallen leaves create an enormous biomass, creating a huge carbon and nitrogen source for microorganisms such as bacteria and fungi (Lodge, 1993). Sundarapandian and Swamy (1999) found that leaf litter in 2 deciduous and 2 evergreen forests of Kodayar forest (Western Ghats, India) contributed from 68-81% (4.1-6.8 Mg/ha/year) of litter fall in the studied sites. In other studies in a tropical forest in Jamaica, Tanner (1981) found that leaf litter production ranged from 4.4-5.5 Mg/ha/year (occupying 74-98% of litter fall, up to the studied sites). Leaf decomposition is a process in which many different microorganisms participate, such as bacteria, fungi and invertebrates. The importance of fungi in terrestrial ecosystems is well known. They are decomposers that can decay highly complex compounds such as lignin and celluloses that other organisms cannot. There have, however been some studies of fungi occurring on leaf litter in temperate as well as in the tropical forests (Aoki *et al.*, 1990; Bills and

Polishook, 1994a; b; Osono, 2002; Tokumasu *et al.*, 1994; Polishook *et al.*, 1996; Promputtha *et al.*, 2002; 2004a; b; c; Paulus *et al.*, 2003; 2006; Duong *et al.*, 2004a; b). Because of limited studies on fungi in tropical forests and the fact that fungal presence is related to the host, it is difficult to establish whether fungal communities of tropical and temperate forests are the similar or different (Hyde *et al.*, 2005; Paulus *et al.*, 2006). Most studies of fungi occurring on leaf litter have been carried out by using direct observation, particle isolation methods or surface washing isolation (Polishook *et al.*, 1996; Paulus *et al.*, 2003; 2006; Duong *et al.*, 2004b; Promputtha *et al.*, 2004). Different methodologies result in different fungal communities being revealed. This is because isolation methods reveal fungi that occur on samples both as dormant spores, mycelia and fungi that fruit on samples. While direct observation focuses on fungi that fruit on the substrates. Those fungi actively participate in substrate decomposition.

Tropical forests are known for their high biodiversity of plants and animals as well as microorganisms. Studies of fungi in tropical forests have been shown to have high diversity. Bills and Polishook (1994a; b) and Polishook *et al.* (1993) isolated large numbers of rare species and few common species by particle filtration from leaf litter in Costa Rica. Parungao *et al.* (2002) directly studied fungi degrading leaf litter of 13 tree species being in Australia and identified 57 microfungi of which 36 species were found only on one plant species, with overlap in only 40% of total species. Paulus *et al.*, (2003) studied diversity of microfungi on decaying leaves of *Ficus pleurocarpa* by particle filtration and 104 species were identified. Promputtha *et al.* (2002) studied fungal succession on senescent leaves of *Manglietia garrettii* in Doi Suthep-Pui National Park and 22 fungal taxa were found. In another study, Promputtha *et al.*

(2004a) reported 37 saprobic fungi on decay leaves of *Magnolia liliifera* collected from Doi Suthep-Pui National Park. These results show relatively high diversity of microfungi on leaf litter. Fungal species composition from previous studies is listed in the Table 2.1. The fungal communities from different hosts studied using different methods differed. Of 431 fungal species, two-hundred and seventy seven were found in one study, 91 on 2 hosts, 35 on 3 hosts, 11 on 4 hosts. Sixteen fungi were found on more than 5 hosts (*Acremonium* sp., *Beltrania rhombica*, *Cladosporium cladosporioides*, *Colletotrichum gloeosporioides*, *Colletotrichum* spp., *Dactylaria* spp., *Fusarium* spp., *Gliocladium* spp., *Idriella lunata*, *Mucor* sp., *Paecilomyces* sp., *Penicillium* spp., *Phoma* spp., *Phomopsis* spp., *Trichoderma harzianum*, *Verticillium* sp.) (Table 2.1). The most common species in all studies cited in the Table 2.2.

Table 2.1 List of fungal species found on leaf litter by various methods and on different tree species.

Species	01	02	03	04	05	06	07	08	09	10
1 <i>Absidia cylindrospora</i>							*			
2 <i>Acanthophyses</i> -like	*									
3 <i>Acremonium</i> sp.	*	*	*	*	*	*	*			
4 <i>Acremonium terricola</i>				*	*					
5 <i>Acrodontium crateriforme</i>			*		*					
6 <i>Acrodontium simplex</i>						*				
7 <i>Albonectria rigiuscula</i>								*		
8 <i>Alternaria alternata</i>						*	*			
9 <i>Alternaria padwickii</i>						*				
10 <i>Alternaria</i> sp.					*					
11 <i>Alysidiopsis</i> sp.						*	*			
12 <i>Angulispora</i> sp.					*					
13 <i>Anthostomella clypeoides</i>									*	
14 <i>Anthostomella clypeata</i>		*								
15 <i>Anthostomella monthadoia</i>								*		
16 <i>Anthostomella reniformis</i>	*									
17 <i>Anthostomella tenacis</i>								*		
18 <i>Anungitea</i> sp.							*			
19 <i>Apiospora montagnei</i>						*				
20 <i>Aposphaera</i> sp.					*					
21 <i>Arachniotus aureus</i>										*
22 <i>Ardhachandra cristaspora</i>			*							
23 <i>Arthrinium phaeospermum</i>							*			

Table 2.1 (Continued)

	Species	01	02	03	04	05	06	07	08	09	10
24	<i>Arthrinium</i> sp.		*								
25	<i>Arxiella terrestris</i>			*							
26	<i>Ascochyta pisi</i>										*
27	<i>Aspergillus fumigatus</i>										*
28	<i>Aspergillus japonicus</i>							*			
29	<i>Aspergillus niger</i>										*
30	<i>Aspergillus oryzae</i>										*
31	<i>Aspergillus</i> sp.		*			*	*				
32	<i>Asterina</i> sp.	*									
33	<i>Asteroma carpini</i>										*
34	<i>Aureobasidium pullulans</i>	*				*	*	*			
35	<i>Beauveria bassiana</i>				*						
36	<i>Beltrania concurvispora</i>	*									
37	<i>Beltrania rhombica</i>	*	*	*		*	*				*
38	<i>Beltrania</i> sp.	*	*								
39	<i>Beltraniella pini</i>						*	*			
40	<i>Beltraniella portoricensis</i>	*	*			*		*			
41	<i>Bionectria ochroleuca</i>								*		
42	<i>Bionectria palmicola</i>								*		
43	<i>Bionectria</i> sp.								*		
44	<i>Bipolaris ellisii</i>						*				
45	<i>Bipolaris halodes</i>									*	
46	<i>Blakeslea trispora</i>						*				
47	<i>Blastobotrys nivea</i>				*						
48	<i>Botryodiplodia theobromae</i>										*
49	<i>Botryosphaeria</i> sp.					*					
50	<i>Botryosporium longibrachiatum</i>					*					
51	<i>Botryotrichum</i> sp.					*					
52	<i>Brooksia tropicalis</i>	*									
53	<i>Camposporium</i> sp.				*						
54	<i>Candida</i> sp.				*						
55	<i>Catenobulispora honiaraensis</i>							*			
56	<i>Cephalosporiopsis</i> spp.	*									
57	<i>Ceptocylidium</i> sp.						*				
58	<i>Ceratopodium</i> sp.				*						
59	<i>Cercospora</i> sp.						*				
60	<i>Ceuthospora</i> sp.					*					
61	<i>Chaetendrophragmia triangulata</i>							*			
62	<i>Chaetomium</i> sp.						*				
63	<i>Chaetophoma</i> sp.			*		*					
64	<i>Chaetopsina fulva</i>	*				*	*	*			
65	<i>Chaetospermum camelliae</i>	*									
66	<i>Chaetospermum carmenum</i>			*							
67	<i>Chaetosphaeria</i> sp.	*				*					
68	<i>Chaetosticta</i> sp.			*	*	*					
69	<i>Chalara affinis</i>							*			
70	<i>Chalara cylindrosperma</i>			*		*					

Table 2.1 (Continued)

Species	01	02	03	04	05	06	07	08	09	10
71 <i>Chalara</i> sp.		*				*				
72 <i>Chalara stipitata</i>							*			
73 <i>Chloridium lignicola</i>					*	*				
74 <i>Chloridium phaeosporum</i>					*		*		*	
75 <i>Chloridium viride</i>										*
76 <i>Choenephora cicurbitarum</i>						*				
77 <i>Circinotricum maculiformw</i>	*				*	*				
78 <i>Cladobotryum mycophilum</i>					*					
79 <i>Cladosporium cladosporioides</i>		*	*	*	*	*				
80 <i>Cladosporium musae</i>				*		*			*	
81 <i>Cladosporium</i> spp.	*	*				*	*			
82 <i>Cladosporium tenuissimum</i>						*	*			
83 <i>Clonostachys</i> spp.			*		*					
84 <i>Clonostachys rosea</i>							*			
85 <i>Cloridium phaeosporum</i>			*	*						
86 <i>Cloridium virescens</i>							*			
87 <i>Colletotrichum constrictum</i>					*					
88 <i>Colletotrichum gloeosporioides</i>				*	*			*	*	*
89 <i>Colletotrichum musae</i>									*	*
90 <i>Colletotrichum</i> spp.	*	*	*		*		*			
91 <i>Coniothyrium</i> sp.					*					
92 <i>Cordana musae</i>			*				*			
93 <i>Corynesporium cassicola</i>			*							
94 <i>Corynesporopsis inaequiseptata</i>									*	
95 <i>Coryneum betunilum</i>										*
96 <i>Cryptophiale</i> sp.			*							*
97 <i>Cryptophiale udagawae</i>							*			
98 <i>Cunninghamella elegans</i>							*			
99 <i>Curcularia clavata</i>						*				
100 <i>Curvularia brachyspora</i>									*	
101 <i>Curvularia cymbopogonis</i>						*				
102 <i>Curvularia eragrostidis</i>						*	*			
103 <i>Curvularia geniculata</i>										*
104 <i>Curvularia inaequalis</i>						*				
105 <i>Curvularia pallescens</i>							*		*	
106 <i>Curvularia</i> sp.	*									
107 <i>Cylindrocarpon destructans</i>				*	*					
108 <i>Cylindrocarpon orthosporum</i>						*				
109 <i>Cylindrocladiella elegans</i>	*									
110 <i>Cylindrocladium colhounii</i>	*									
111 <i>Cylindrocladium floridanum</i>	*							*		
112 <i>Cylindrocladium illicola</i>	*		*							
113 <i>Cylindrocladium retaudii</i>	*									
114 <i>Cylindrosyndium cryptocaryacola</i>	*		*							
115 <i>Cylindrosyndium variabile</i>	*				*					
116 <i>Cyphellophora taiwanensis</i>			*	*	*					

Table 2.1 (Continued)

Species	01	02	03	04	05	06	07	08	09	10
117 <i>Cystodendron</i> spp.				*						
118 <i>Cytospora</i> sp.					*					
119 <i>Dactylaria acerosa</i>			*							
120 <i>Dactylaria belliana</i>	*									
121 <i>Dactylaria briphora</i>							*			
122 <i>Dactylaria dimorphospora</i>								*		
123 <i>Dactylaria fuscicola</i>	*									
124 <i>Dactylaria fusiformis</i>							*			
125 <i>Dactylaria longidentata</i>								*		
126 <i>Dactylaria naviculiformis</i>						*	*			
127 <i>Dactylaria</i> spp.	*	*	*	*	*	*	*		*	
128 <i>Dactylella</i> spp.	*				*				*	
129 <i>Dactylosporium</i> sp.				*						
130 <i>Deightoniella torusola</i>					*				*	
131 <i>Dendrodochium</i> spp.				*	*					
132 <i>Dendrosporium lobatum</i>	*		*							
133 <i>Diapothe</i> sp.										*
134 <i>Dicrandion fragile</i>					*					
135 <i>Dictyoarthrinium africanum</i>		*								
136 <i>Dictyochaeta daphnioides</i>										*
137 <i>Dictyochaeta gamundii</i>			*							
138 <i>Dictyochaeta simplex</i>							*			
139 <i>Dictyochaeta</i> spp.	*	*	*			*				
140 <i>Dictyochaeta parva</i>										*
141 <i>Dictyosporium elegans</i>				*						
142 <i>Dictyosporium heptasporum</i>									*	
143 <i>Didymosphaeria futilis</i>									*	*
144 <i>Diplodia</i> sp.			*						*	
145 <i>Discostroma fuscicola</i>	*									
146 <i>Dokmaiensis monthadangii</i>								*		
147 <i>Dothiorina</i> sp.			*							
148 <i>Durispora musae</i>									*	
149 <i>Endophragmiella bouwei</i>							*			
150 <i>Eriocercophora balladynae</i>					*					
151 <i>Exophiala</i> spp.			*	*	*					
152 <i>Falcocladium</i> sp.	*									
153 <i>Fusarium sambucinum</i>				*						
154 <i>Fulvia fulva</i>						*				
155 <i>Fusarium decamcellulare</i>			*	*						
156 <i>Fusarium oxisporum</i>				*						
157 <i>Fusarium semitectum</i>						*	*			
158 <i>Fusarium solani</i>			*	*		*	*			
159 <i>Fusarium</i> spp.		*	*	*	*	*	*	*		
160 <i>Gaeumannomyces</i> sp.	*									
161 <i>Geniculosporium</i> sp.			*				*			
162 <i>Geotrichum</i> sp.	*	*	*							
163 <i>Gliocephalotrichum</i> sp.		*								

Table 2.1 (Continued)

Species	01	02	03	04	05	06	07	08	09	10
164 <i>Gliocladiopsis tenuis</i>	*				*					
165 <i>Gliocladium roseum</i>				*	*	*				
166 <i>Gliocladium solani</i>	*				*					
167 <i>Gliocladium</i> spp.	*	*	*					*		*
168 <i>Gliocladium viride</i>					*		*			
169 <i>Gliomastix elasticae</i>	*									
170 <i>Gliomastix macrocerealis</i>	*									
171 <i>Glomerella cingulata</i>			*							
172 <i>Glomerella</i> sp.	*				*				*	
173 <i>Gnomonia petiolorum</i>										*
174 <i>Gnomoniella</i> sp.										*
175 <i>Gonatobotrys</i> sp.							*			
176 <i>Gonitrychum chlamydosporium</i>			*		*					
177 <i>Graphium penicilliodes</i>					*					
178 <i>Guignardia</i> spp.	*							*		*
179 <i>Guilia</i> sp.			*							
180 <i>Gynotrichum</i> sp.						*				
181 <i>Gyrophthrix circinata</i>		*				*	*			
182 <i>Gyrophthrix pediculata</i>		*	*							
183 <i>Gyrophthrix podosperma</i>						*	*			
184 <i>Haematonectria haematococca</i>								*		
185 <i>Hansfordia ovalispora</i>									*	
186 <i>Hansfordia pulvinata</i>	*		*			*				
187 <i>Haplographium catenatum</i>			*	*	*					
188 <i>Haplographium</i> sp.										*
189 <i>Helicoma palmegenum</i>				*						
190 <i>Helicosporium griseum</i>	*									
191 <i>Helicosporium</i> sp.	*	*								
192 <i>Henicospora cylindroclavata</i>							*			
193 <i>Heteroconium</i> sp.					*					
194 <i>Hyalodendrom</i> sp.							*			
195 <i>Hyponectria manglietiae</i>								*		
196 <i>Hyponectria manglietiagarrettii</i>								*		
197 <i>Hyponectria</i> sp.								*	*	
198 <i>Hyponectria suthepensis</i>								*		
199 <i>Hypoxydon</i> sp.					*			*		
200 <i>Hysteraceae</i>	*									
201 <i>Idriella cognizarii</i>	*									
202 <i>Idriella fertina</i>							*			
203 <i>Idriella lunata</i>	*		*	*	*		*			
204 <i>Idriella ramosa</i>	*				*					
205 <i>Idriella</i> sp.	*	*	*		*					
206 <i>Ijuhya parilis</i>								*		
207 <i>Iodosphaeria phyllophyla</i>		*								
208 <i>Isthmolongispora minima</i>					*					
209 <i>Kazulia vagans</i>					*					
210 <i>Kramasamuha sibika</i>						*				

Table 2.1 (Continued)

Species	01	02	03	04	05	06	07	08	09	10
211 <i>Kutilakesopsis macalpinae</i>			*	*						
212 <i>Lanceispora amphibia</i>	*									
213 <i>Lasiodiplodia theobromae</i>			*	*						
214 <i>Lasiosphaeria</i> sp.								*	*	
215 <i>Lemonniera terrestris</i>	*									
216 <i>Leptodiscella africana</i>			*		*					
217 <i>Leptodotherella state of Guignardia</i>	*									
218 <i>Leptographium</i> sp.					*					
219 <i>Leptothyrium</i> sp.	*									
220 <i>Libertella</i> sp.			*	*						
221 <i>Linodochium</i> spp.	*				*					
222 <i>Macrophoma</i> sp.										*
223 <i>Malbranchae</i> sp.				*						
224 <i>Marandina arnaldi</i>						*				
225 <i>Marandina aunardii</i>							*			
226 <i>Marandina corticola</i>						*				
227 <i>Mariannaea elegans</i>						*	*			
228 <i>Mariannaea oryzae</i>							*			
229 <i>Massarina rubi</i>									*	
230 <i>Melaconiopsis</i> sp.			*							
231 <i>Meliola</i> sp.	*									
232 <i>Memnoniella subsimplex</i>									*	
233 <i>Menisporopsis theobromae</i>		*			*					
234 <i>Metarhizium anisopliae</i>			*	*						
235 <i>Microdochium phragmites</i>	*									
236 <i>Microdochium</i> sp.	*				*					*
237 <i>Microsphaeropsis</i> sp.			*	*	*					
238 <i>Mirandina</i> sp.					*		*			
239 <i>Monacosorium</i> spp.							*			
240 <i>Monieliella</i> sp.					*					
241 <i>Monocillium tenue</i>							*			
242 <i>Monocrosporium</i> sp.						*				
243 <i>Mortieriella isabellina</i>					*	*	*			
244 <i>Mortieriella ramanniana</i>						*	*			
245 <i>Mortieriella vinacae</i>			*		*					
246 <i>Mortieriella exigua</i>								*		
247 <i>Mucor</i> sp.		*	*	*	*	*	*			*
248 <i>Munkvalsaria bipolaris</i>								*		
249 <i>Mycena</i> sp.					*					
250 <i>Mycoenterlobium platysporum</i>					*					
251 <i>Mycoleptodiscus terrestris</i>			*		*					
252 <i>Mycosphaerella</i> sp.									*	*
253 <i>Mycothecium prestonii</i>			*	*						
254 <i>Myrothecium cinctum</i>				*						
255 <i>Myrothecium lavor-viride</i>				*						
256 <i>Myrothecium lachastrae</i>	*	*								
257 <i>Myrothecium leucotrichum</i>			*		*					

Table 2.1 (Continued)

Species	01	02	03	04	05	06	07	08	09	10
258 <i>Myrothecium rirodum</i>			*	*		*	*			
259 <i>Myrothecium verrucaria</i>							*			
260 <i>Nectria flavolanata</i>					*					
261 <i>Nectria haematococca</i>				*						
262 <i>Nectria lasiacidis</i>			*							
263 <i>Nectria rugulosa</i>					*					
264 <i>Nectria</i> sp.									*	
265 <i>Nectriella</i> sp.			*							
266 <i>Nectriopsis</i> sp.				*						
267 <i>Neotiosporina</i> sp.				*						
268 <i>Nigrospora oryzae</i>						*	*		*	
269 <i>Nigrospora panici</i>	*									
270 <i>Nigrospora sacchari</i>						*				
271 <i>Nigrospora sphaerica</i>						*	*			
272 <i>Nodulisporium</i> spp.			*	*	*					
273 <i>Ochroconis humicola</i>	*									
274 <i>Olpitrichum sphaerospermum</i>							*			
275 <i>Ophioceras</i> sp.									*	
276 <i>Ophiognomonina elasticae</i>	*									
277 <i>Ophiostoma</i> sp.					*					
278 <i>Paecilomyces marquandii</i>			*	*	*					
279 <i>Paecilomyces</i> sp.			*	*	*		*			*
280 <i>Parasymphodiella longispora</i>						*	*			
281 <i>Parasymphodiella</i> sp.	*									
282 <i>Peiconiella musae</i>									*	
283 <i>Penicillium</i> spp.	*	*	*		*	*	*			*
284 <i>Periconia digitata</i>									*	
285 <i>Periconia jabalpurensis</i>								*		
286 <i>Periconia</i> sp.		*				*				
287 <i>Pestalotiopsis adusta</i>										*
288 <i>Pestalotiopsis breviseta</i>	*	*				*				
289 <i>Pestalotiopsis foedans</i>							*			
290 <i>Pestalotiopsis glandicola</i>							*			
291 <i>Pestalotiopsis guepinii</i>			*	*						
292 <i>Pestalotiopsis maculans</i>					*					
293 <i>Pestalotiopsis neglecta</i>							*			
294 <i>Pestalotiopsis phoenicis</i>										*
295 <i>Pestalotiopsis theae</i>					*					
296 <i>Phaedactylum</i> sp.							*			
297 <i>Phaeoisaria</i> sp.				*	*					
298 <i>Phaeoramularia hachijoensis</i>							*			
299 <i>Phaeoramularia</i> sp.						*				
300 <i>Phaeosphaeria</i> sp.								*		
301 <i>Phiostalagmus tenuissimus</i>										*
302 <i>Phialemonium</i> sp.				*	*					
303 <i>Phialocephala bactrospora</i>							*		*	
304 <i>Phialocephala humicola</i>						*				

Table 2.1 (Continued)

Species	01	02	03	04	05	06	07	08	09	10
305 <i>Phialomyces macrosporus</i>							*			
306 <i>Phialophora</i> sp.			*	*	*					
307 <i>Phoma</i> spp.	*	*	*	*	*	*	*	*	*	*
308 <i>Phomatospora</i> sp.									*	
309 <i>Phomopsis</i> spp.	*	*	*	*	*	*		*	*	
310 <i>Phyllosticta</i> sp.		*				*				*
311 <i>Physalospora</i> sp.								*		
312 <i>Pithomyces maydis</i>			*				*			
313 <i>Polycephalomyces</i> sp.					*					
314 <i>Polyscytalum</i> sp.	*					*	*			
315 <i>Pseudobilaridia sojae</i>					*					*
316 <i>Pseudobotrytis terrestris</i>					*		*			
317 <i>Pseudohalonectria suthepensis</i>								*		
318 <i>Pseudospiropes pinarensis</i>	*									
319 <i>Pyricularia</i> sp.			*							
320 <i>Pyriculariopsis parasitica</i>									*	
321 <i>Ramichloridium cephaliosum</i>						*				
322 <i>Ramichloridium clavulisorum</i>					*					
323 <i>Ramichloridium musae</i>				*		*	*			
324 <i>Ramichloridium</i> sp.			*		*					
325 <i>Ramichloridium schulzeri</i>							*			
326 <i>Ramularia</i> sp.					*					
327 <i>Rhinoctadiella</i> sp.		*	*		*	*				
328 <i>Rhinoctadiella atrovirens</i>							*			
329 <i>Rhizoctonia</i> sp.			*							
330 <i>Rhytisma</i> sp.								*		
331 <i>Rosellinia</i> sp.					*					
332 <i>Sagenomella verticillita</i>					*					
333 <i>Sarcopodium coffeanum</i>					*					
334 <i>Sclecophoma</i> sp.					*					
335 <i>Scolecobasidium constrictum</i>			*	*	*		*			
336 <i>Scolecobasidium crassihumicola</i>			*							
337 <i>Scolecobasidium gamsii</i>						*				
338 <i>Scolecobasidium humicola</i>			*			*	*			
339 <i>Scolecobasidium tricladiatum</i>							*			
340 <i>Selenodriella fertilis</i>	*									
341 <i>Selenosporella cristata</i>	*						*			
342 <i>Septofusidium variabilis</i>			*		*					
343 <i>Septomyrothecium uniseptata</i>					*					
344 <i>Septonema</i> sp.				*						
345 <i>Seridium anceps</i>			*							
346 <i>Sesquicillium buxi</i>			*							
347 <i>Sesquicillium candelabrum</i>					*					
348 <i>Sesquicillium setosum</i>			*							
349 <i>Sesquicillium</i> sp.					*		*			
350 <i>Solheimia costaspora</i>			*	*						
351 <i>Solosympodiella clavata</i>			*							

Table 2.1 (Continued)

Species	01	02	03	04	05	06	07	08	09	10
352 <i>Speiropsis hyalospora</i>			*							
353 <i>Speiropsis pedatospora</i>	*	*								
354 <i>Sphaeropsis sobglobosa</i>				*	*					
355 <i>Spiropes</i> sp.			*							
356 <i>Sporidesmium crassisporum</i>								*		
357 <i>Sporidesmium</i> sp.							*			
358 <i>Sporodesmium goidanichii</i>							*			
359 <i>Sporodesmium</i> -like	*			*						
360 <i>Sporothrix</i> sp.					*		*			
361 <i>Stachybotryna</i> sp.					*					
362 <i>Stachybotrys kampalensis</i>			*	*						
363 <i>Stachybotrys nephrospora</i>						*				
364 <i>Stachybotrys parvispora</i>			*				*	*		
365 <i>Stachybotrys renoformis</i>			*							
366 <i>Stachybotrys</i> sp.		*							*	
367 <i>Stachybotrys chartarum</i>			*							
368 <i>Stachylidium bicolor</i>				*					*	
369 <i>Stemphylium botryosum</i>									*	
370 <i>Stenella plectroniae</i>						*				
371 <i>Sterella variabilis</i>							*			
372 <i>Sterigmatomyces</i> sp.				*						
373 <i>Stibella</i> sp.				*	*					
374 <i>Stibilla annulata</i>				*						
375 <i>Subulispora procurvata</i>	*									*
376 <i>Sympodiella</i> sp.			*							
377 <i>Tetracladium breve</i>			*							
378 <i>Tetracladium setigerum</i>			*							
379 <i>Tetraploa aristata</i>									*	
380 <i>Thozetella cristata</i>							*			
381 <i>Thozetella falcata</i>	*									
382 <i>Thozetella radicata</i>		*	*	*						
383 <i>Thozetella</i> sp.					*	*				
384 <i>Thozetella tocklaiensis</i>						*				
385 <i>Thysanophora</i> sp.		*								
386 <i>Tilletiopsis</i> sp.					*					
387 <i>Tolypocladium</i> sp.				*	*					
388 <i>Torula herbarum</i>									*	
389 <i>Torula</i> sp.		*								
390 <i>Torulomyces lagena</i>					*					
391 <i>Trichoderma harzianum</i>			*	*	*	*	*			
392 <i>Trichoderma aureoviride</i>							*			
393 <i>Trichoderma crassum</i>							*			
394 <i>Trichoderma hamatum</i>				*	*	*				
395 <i>Trichoderma koningii</i>			*			*	*			
396 <i>Trichoderma</i> spp.	*					*	*			
397 <i>Trichoderma tomentosum</i>							*			
398 <i>Trichoderma virens</i>							*			

Table 2.1 (Continued)

Species	01	02	03	04	05	06	07	08	09	10
399 <i>Trichoderma viride</i>	*	*								
400 <i>Tricladium</i> sp.						*				
401 <i>Trinacrium</i> sp.			*		*					
402 <i>Tripaspermum</i> sp.					*					
403 <i>Tritriachrium</i> sp.					*					
404 <i>Tubercularia lateritia</i>			*							
405 <i>Tubercularia</i> sp.			*							
406 <i>Ulocladium botrytis</i>						*				
407 <i>Veronaea carlinae</i>						*	*		*	
408 <i>Verticicladium trifidum</i>						*	*			
409 <i>Verticillium balanoides</i>							*			
410 <i>Verticillium lecanii</i>						*				
411 <i>Verticillium psalliotiae</i>				*						
412 <i>Verticillium</i> sp.	*		*	*	*		*		*	
413 <i>Verticillium theobromae</i>				*						
414 <i>Verticimonosporium ellipticum</i>					*					
415 <i>Virgarilla</i> sp.				*						
416 <i>Volucrispora aurantiaca</i>					*					
417 <i>Volutella minima</i>			*	*	*		*			
418 <i>Volutella ramkamarii</i>							*			
419 <i>Volutella ramkurii</i>	*									
420 <i>Volutella</i> sp.			*		*			*		
421 <i>Wardomyces</i> sp.		*								
422 <i>Wiesneriomyces javanicus</i>	*	*								
423 <i>Wiesneriomyces</i> sp.	*	*								
424 <i>Xenobotrytis</i> sp.					*					
425 <i>Xenocladium</i> -like	*									
426 <i>Xylaria</i> spp.			*	*	*					
427 <i>Zalerion</i> sp.					*					
428 <i>Zygosporium echinosporium</i>	*									
429 <i>Zygosporium gibbum</i>			*				*			
430 <i>Zygosporium mansonii</i>	*									*
431 <i>Zygosporium oscheoides</i>									*	*

01 Fungi on *Ficus pleurocarpa* (Moraceae) (Paulus *et al.*, 2006)

02 Fungi on leaf litter using particle filtration method (Paulus *et al.*, 2003)

03 Fungi on leaf litter of lowland forest in Costa Rica (Bills and Poliskook, 1994a)

04 Fungi on leaf litter of *Heliconia mariae* (Bills and Poliskook, 1994b)

05 Microfungi on decay leaves in two forests in Puerto Rico (Poliskook *et al.*, 1996)

06 Fungi on decaying pine needles in Thailand (Tokumasu *et al.*, 1997)

07 Fungi on decaying pine needles in subtropical forest in Japan (Tokumasu and Aoki, 2002)

08 Fungi on dead leaves of *Magnolia liliifera* in Thailand (Promputha *et al.*, 2004a)

09 Fungi on dead wild banana (Photita *et al.*, 2003)

10 Fungi on dead leaves of *Castanopsis fissa* in Hong Kong (Tang *et al.*, 2005)

Table 2.2 List of common microfungi on decaying leaves using particle filtration method in different tree species and different areas (summarized from cited studied).

Species	Species
<i>Acremonium</i> spp.	<i>Idriella lunata</i>
<i>Aspergillus</i> sp.	<i>Idriella</i> sp.
<i>Aureobasidium pullulans</i>	<i>Mucor</i> sp.
<i>Beltrania rhombica</i>	<i>Penicillium</i> spp.
<i>Beltraniella portoricensis</i>	<i>Phoma</i> spp.
<i>Cladosporium cladosporoides</i>	<i>Phomopsis</i> spp.
<i>Cladosporium</i> spp.	<i>Rhinochadiella</i> sp.
<i>Colletotrichum</i> spp.	<i>Stachybotrys parvispora</i>
<i>Cyphellophora taiwanensis</i>	<i>Thozetella radicata</i>
<i>Dactylaria</i> spp.	<i>Trichoderma harzianum</i>
<i>Dictyochaeta</i> spp.	<i>Trichoderma</i> spp.
<i>Fusarium solani</i>	<i>Verticillium</i> sp.
<i>Fusarium</i> spp.	<i>Volutella</i> sp.

2.3 Methods to study fungal communities on leaf litter

2.3.1 Conventional methods

Particle filtration and direct observations are the methods generally used to study leaf litter fungi. Cultural methods are, in most respects, less satisfactory than direct observation. The main disadvantage is that cultural techniques do not allow a very accurate distinction to be made between fungi that were growing at the time plating out and those which were dormant spores (Dix and Webster, 1995). Particle filtration generally results in larger numbers of isolates, with numerous rare species (Polishook *et al.*, 1996; Paulus *et al.*, 2003; 2006). Many of the fungi obtained by particle filtration are, however, sterile mycelia. Bills and Polishook (1994a) used particle filtration to estimate fungal diversity on mixed leaf litter in a lowland forest of Costa Rica and 177 species were recorded. These authors also used the same method for studies on fungal diversity in a single tree of *Heliconia mariae* (Heliconiaceae) and 137 species were identified (Bills and Polishook, 1994b). Paulus *et al.*, (2003) studied diversity of microfungi on decaying leaves of *Ficus pleurocarpa* by using the same method as Bills and Polishook (1994a; b) and more than 104 species were

identified. It is not clear whether all fungi isolated via the particle filtration method were involved in litter decay or whether dormant spores are isolated. Therefore the direct observation method is preferred in identifying fungal communities on leaf litter, although it results in fewer species. Fungi found from direct observation are almost certainly participating in litter decomposition. Parungao *et al.* (2002) directly studied fungi on decaying leaf litter of 13 tree species in Australia resulting in 57 species. Paulus *et al.* (2003) used particle filtration and direct observation to estimate fungal diversity on leaf litter of *Neolitsea dealbata* (Lauraceae) and 86 species were recorded by the first method and 28 species by the latter, with only 14 overlapping species.

2.3.2 Molecular methods

Recently, molecular techniques, characterizing the sequence and diversity of nucleic acids, have been applied to study microbial communities in soil or other environmental samples. There have been several methods that have been used in analyzing fungal communities such as Terminal Restriction Fragment Length Polymorphism (T-RFLP) (Buchan *et al.*, 2002; Klammer *et al.*, 2002), Denaturing Gradient Gel Electrophoresis (DGGE) (Bougoure and Caine, 2005; Nikolcheva and Bärlocher, 2005; Nikolcheva *et al.*, 2005), Temperature Gradient Gel Electrophoresis (TGGE) (Muyzer, 1999), Amplified rDNA Restriction Analysis (ARDRA) (Schlegel *et al.*, 2003), Amplified Random Intergeneric Spacer Analysis (ARISA) (Kent *et al.*, 2006), Oligonucleotide Fingerprinting of rRNA genes or Single-Stranded-Conformation Polymorphism (SSCP) (Peters *et al.*, 2000). DGGE and T-RFLP have been used to analyse fungal communities occurring on leaf litter (terrestrial and freshwater) (Nikolcheva *et al.*, 2003, 2005).

DGGE is one of the most useful modern techniques to investigate microbial communities in environmental samples. DGGE has been used to study fungal communities from several environmental samples (Kowalchuk *et al.*, 1997; Smit *et al.*, 1999; May *et al.*, 2001; Piñar *et al.*, 2001; Nikolcheva *et al.*, 2003; Souza *et al.*, 2004; Nikolcheva and Bärlocher, 2005). The basis of this method depends on the melting properties of different DNA fragments. The DNA extracted from given environmental samples is amplified with a taxon specific primer pair attached to a GC clamp. Purified PCR products are separated through an acrylamide gel containing gradually increasing gradients of denaturants (formamide and urea). Sequences with different base composition possess different melting behavior and migrate to different positions in the gels. Each band probably represents a microbial taxon. The bands can then be excised, soaked in water overnight and used either as template DNA for reamplifying or construction of clone libraries.

T-RFLP has been shown as a high-throughput method developed in bacterial ecology. In T-RFLP method, one or both two fluorescently labeled primers at the 5' end are used to amplify the extracted DNA. The PCR products are then digested by one restriction enzyme and the labeled terminal fragments are separated and detected on a DNA sequencer. The number of fragments detected is indicative of the number of phylogenetically different strains (phlotypes) present in a sample (Liu *et al.*, 1997). The disadvantage of the method is that it cannot be used to identify fungal species or strains. However, it provides a good estimate of the number of fungal phlotypes on a substrate. This is a fast and high-throughput method that has been used to characterise fungal communities occurring on leaves in freshwater environments (Nikolcheva *et al.*, 2003).

2.4 Leaf litter fungi and their role in nutrient recycling

Plant growth is positively correlated with the availability of nutrients in the soils in which they grow. Fungi are very important decomposers in the terrestrial ecosystem, contributing in the recycling mineral nutrient processes and in the humus formation process in forests (Swift *et al.* 1977, Frankland, 1982). Fungi possess valuable capacities in degrading highly complex structure molecules such as lignin and holocellulose. In addition, fungi can digest high weight molecules into soluble ones which can be used by the fungus or for plants (Cotrufo *et al.*, 2000). This capacity is not only effective in terrestrial ecosystems, but also in other ecosystems. Aquatic hyphomycetes, a phylogenetically heterogeneous group of true fungi dominate the breakdown of leaves and other allochthonous detritus in streams and rivers (Bärlocher, 1992; Gessner *et al.*, 2002). Fungal activities in freshwater environments increase the palatability of the detritus to feeders such as invertebrates. Fungal decay of leaves in freshwater ecosystems also results in different feeding preferences of macro-invertebrates (Rong *et al.*, 1995).

2.5 The northern forest of Thailand

2.5.1 Geographical and climate conditions

The northern forest of Thailand occurs in a high region (724 up to 2565m altitude) with many streams and rivers. The climate of northern Thailand is strongly seasonal. There are three distinct seasons: a cool dry season from November to March; a hot dry season from March to May; and a warm wet season from May to November. The annual rainfall varies from 1100 to 1500 mm, with over 80% of the annual rainfall

within the 6 months rainy season, whilst the months of December, January and February are virtually without rain (Gardner *et al.*, 2000).

Doi Suthep-Pui National Park is a typical tropical forest in northern Thailand. The studied area was situated at 1100-1200 m high, 18 km to the northeast of Chiang Mai. The highest peak of Doi Suthep-Pui is 1685 m above the sea level. At the high altitude, the temperature is lower than that of the lower altitude. It makes the annual average temperature of the area lower, from 20 to 23 degree Celsius. In the dry season (middle of December to end of February), the temperature at high elevations is low. The rainy season at Doi Suthep-Pui National Park begins at the middle of May and ends at the beginning of November. August and September are the wettest months in the year with daily rain (<http://www.dnp.go.th/parkreserve/asp/style2/default>).

2.5.2 Flora in the forest

The northern forests of Thailand are divided into three regions: lowland forest (< 800 m); mid-elevation forests (800-1200 m) and highland forests (1200-2565 m). The variation in topography creates a high diversity in the forest flora. Forests in northern Thailand possess a high diversity of trees with about 70 tree species in the lowland forests and about 80 tree species in the highland forests (Gardner *et al.*, 2000).

Doi Suthep-Pui encompasses 261.06 km² forest area. There are almost 2000 species of plants. Many of them are endemic species. The studied area comprises a mixture of evergreen and deciduous trees including the common families Dipterocarpaceae, Fagaceae, Magnoliaceae, Myrtaceae and Theaceae.

2.5.3 Studies of fungal diversity in the northern Thailand

Chiang Mai is a province of the North of Thailand. This is a region that contains large areas of tropical forests. The floral diversity is notable. The tropical floral result in a high diversity of microorganisms. In any ecosystem there are three groups: the providers; the consumers; and the decomposers (Atlas and Bartha, 1998). The latter comprise fungi that decompose organic materials, completing the organic material cycle. There have been several studies on fungi in northern Thailand in recent years (Lumyong *et al.*, 2002; Bussaban *et al.*, 2003; Promputtha *et al.*, 2005).

Before 1990, reports on fungal diversity in Thailand were rare (Jones and Hyde, 2004). In the early part of the 20th century, there were several publications of Thai fungi by Danish mycologists (Rostrup, 1902; Vainio, 1909). During the next period (after 1921 to 1990) there were some other mycologists who collected macrofungi in Thailand (Carroll, 1963; Brummelen, 1967; 1976; Ryvardeen, 1976; Ellingsen, 1982, Høiland and Schumacher, 1982). In fact, there has been an increasing interest and publications on Thai fungi since the 1990s. Many new species have been described. Over the last 5 years, there have been a notable number of publications on fungal diversity on different substrates in northern forests of Thailand. The most impressive result was the book titled “Thai fungal diversity” edited by Jones *et al.* (2004). Studies of endophytic fungi have recorded many taxa (Lumyong *et al.*, 2000; Bussaban *et al.*, 2001a; b). Sanmee *et al.* (2003) found 19 species of *Amanita* of which one was a new species.

The fungi occurring on leaf litter are particularly important in any terrestrial ecosystem and therefore need to be studied. It is also important to know and

understand how fungal communities from different plant species differ. This has important implications in fungal number estimations.

2.6 Tree species studied

2.6.1 *Castanopsis acuminatissima* Blume

Castanopsis acuminatissima occurs in the Fagaceae (Fagales, Magnoliopsida). It is evergreen tree species with a trunk up to 25 m high. The bark is dark brown, with deep fissures, 1-2 cm thick. The leaf sizes range from 5-15 × 2.5-6 cm, and are lanceolate with a tapering tip and blunt or rounded base, and smooth or slightly toothed near top only. The mature leaves have dark green color and glossy above, and slightly silvery with minute scale below. The midrib is slightly sunken above, with 8-12 pairs of arched side veins, raised above. The petioles are 0.6-1.5 cm, grooved, drying, and dark brown to black. The twigs are slender, dark brown with conspicuous lenticels. The buds are subglobose, with 2-3 scales at base. The fruits are 1.5-2 × 1-1.3 cm, obliquely ovoid, with 4-5 widely spaced rows of short spines. The cupules are thin-walled, silky hairy inside, splitting irregularly when dry. It has 1 (2) nuts, which are 0.8-1.2 cm, ovoid with slightly pointed tips and a flat inner surface, and smooth or slightly hairy (Gardner *et al.*, 2000)

2.6.2 *Castanopsis diversifolia* (Kurz) King ex Hook. f.

Castanopsis diversifolia is deciduous or partly deciduous tree with a trunk height from 10-20 m. The bark is moderately cracked; the inner bark is pale yellow. The leaves are 8-24 × 4-12 cm, ovate, oval or oblong with tapering or almost blunt tips and rounded or slightly pointed base. The young leaves are brown hairy; the

mature leaves are leathery, smooth above, and usually with sparsely hairy at least on vein below. There are 10-14 pairs of conspicuous side vein. The stalks are 1.2-2 cm stout, and are brown hairy when young. The fruits are 3.5-5.5 cm, without stalks, globose or ovoid, and finally splitted into 2-4 parts when ripe. The cupules are not



Figure 2.1 *Castanopsis acuminatissima* from forests in northern Thailand.



Figure 2.2 *Castanopsis diversifolia* from forests in northern Thailand.

woody, and are completely covered with sharp spines, which are 8-20 mm, radiating in dense cluster of 5-8. The nuts are 1.5-2 cm, softly hairy, and slightly flatten with scars that cover 1/3-1/2 of nuts. This species is common and wide spread in evergreen forests often gregarious. (Gardner *et al.*, 2000).

2.6.3 *Lithocarpus polystachyus* (Wallich ex A. de Candolle) Rehder

Lithocarpus polystachyus occurs in the Fagaceae (Thai name: Goh Pat). It has small or medium trunk up to 15 m high. The bark is grayish, smooth, and often with long vertical bold wide furrows in old trees at base. The inner bark is streaked red and white. The leaves are 10-20 x 5-8 cm, narrowly ovate, oblong-elliptic or lanceolate with tapering tips and pointed base, and smooth margin. The young shoots are finely hairy; the mature leaves are thinly leathery, smooth with scattered fine hairs, glaucous

below. There are 8-13 pairs of side veins that are thin but conspicuous with fine ladder like tertiary veins. The stalks are 0.8-2.5 cm, very slightly winged near top, smooth. The fruits fused in clusters of 2-3 on short common stalks. The cups are 0.8-1.5 cm diameter, narrower than stout central stalks, in saucer shaped. They cover 1/3 of nuts. The nuts are 0.8-1.7 cm, globose, blunt ovoid, yellow-brown, and smooth shiny with a slightly concave scar (Gardner *et al.*, 2000).



Figure 2.3 *Lithocarpus polystachyus* from forests in northern Thailand.



Figure 2.4 *Schima wallichii* from forests in northern Thailand.

2.6.4 *Schima wallichii* (DC.) Korth

Schima wallichii is a species in the Theaceae (Thai name: Ta low) (Ericales, Magnoliopsida). It is a big tree species with a dense, deep crown and straight trunk up to 35 m. The bark is dark grey or almost black, deeply cracked into angular pieces. The inner bark is often pink or dark red, fibrous. The leaves are extremely variable, that are 4.5-18 × 2-8 cm, broadly ovate, elliptic to lanceolate, usually with a slightly or abruptly tapering tip and narrow or rounded base. They are mostly without teeth but sometimes with scattered blunt especially near the tip. The young leaves are pinkish and densely covered with silky hairs. The mature leaves are smooth, dark

green above, often pale grey-green with silky hairs below. The mid-veins are usually sunken but other veins rose on upper surface. The stalks are quite slender, 0.3-3.5 cm long, and sometimes slightly winged. The old leaves never turn yellow or red on the trees. They fall when they are still green. The flowers are 2-5 cm, white, solitary or clustered in the axils of leaves near the end of twigs. The fruits are 1.5-3 cm, surrounded by woody spherical capsules that are splitted into 5 sections (Gardner *et al.*, 2000).

2.6.5 *Syzygium albiflorum* (Duthie & Kurz) K.N. Bahadur & R.C. Gaur

Syzygium albiflorum is a species in Myrtaceae (Myrtales, Magnoliopsida). The trunk is up to 20 m high. The bark is red-brown or pale grey, slightly flaky or quite deeply cracked. The leaves are 9-14 × 3.5-6 cm, narrowly ovate or lanceolate with pointed or blunt tips and slightly tapering base. There are 7-13 pairs of side veins. The mid-vein is sunken above. The stalks are 1-1.8 cm, slender. The flowers are white or cream, in forked cluster at the end of twigs and at the upper leaf axils. They are 3-6 cm usually with several branches from base. The buds are 4-7 mm. The calyx cups are 6-8.5 mm, funnel-shape with distinct stalks, which are 2.5-4.5 mm, with 4 large round lobes, 4 free petals. The outer stamens 7-13 mm, with a stipe 8.5-15 mm. The fruits are (0.5) 1.2-3.5 cm, pale green to dark purple black, globose. This species is common in evergreen forests (Gardner *et al.*, 2000).



Figure 2.5. *Syzygium albiflorum* from forests in northern Thailand.

2.7 Study of fungal communities on these hosts

The fungi on *Castanopsis* have been reasonably well documented especially on different host species from temperate regions. There are approximately 120 *Castanopsis* species (species 2000, Annual checklist 2005). Farr *et al.* (2006) enumerated 324 fungal records of 189 species on 34 *Castanopsis* species all over the world (see Appendix A). However, there were other 38 new records on *C. fissa* in Hong Kong (Tang *et al.*, 2005), bringing the number of fungal species on *Castanopsis* to 362 records. However, prior to this study, there are not any fungal records on *C. diversifolia* and only a single fungal record on *C. acuminatissima* in Papua New Guinea (Shaw, 1984).

There are 14 records of 7 fungal species (*Coriolus versicolor*, *Corticium salmonicolor*, *Daedaleopsis confragos*, *Meliola schimicola*, *Meliola theacearum*, *Pestalotiopsis schimae* and *Polystictus versicolor*) on *Schima* (see Appendix A), in which only one (*Corticium salmonicolor* from Nepal) is on *S. wallichii* (Dahal *et al.*, 1992).

One hundred and seventy-one records of 106 fungal species are recorded on 33 *Lithocarpus* species (see Appendix A) but there have not been any species recorded on *L. polystachyus*. Similarly, there are 361 fungal records of 249 species on 31 *Syzygium* species (see Appendix A). However, there are no records from *S. albiflorum*.

2.8 Objectives and usefulness of the study

This is the first study of fungal communities on *C. acuminatissima*, *C. diversifolia*, *L. polystachyus*, *Schima wallichii* and *Syzygium albiflorum* in Thailand and first study in the world for *C. diversifolia*, *L. polystachyus* and *S. albiflorum*.

2.8.1 Objectives

The present study aims to 1) study the diversity of saprobic fungi on leaf litter of five selected tree species in Doi Suthep-Pui National Park, Chiang Mai, Thailand; 2) study the succession of fungi on senescent leaves of *Castanopsis diversifolia*; 3) study relationship between the host diversity and fungal diversity; 4) establish the genetic diversity of fungi on leaf litter of *Castanopsis diversifolia* based on the DGGE method as compared to traditional methods; and 5) clarify phylogenetic relationship of the genus *Guignardia* (Botryosphaeriaceae) and its anamorph *Phyllosticta* a common plant endophyte, pathogen, and saprobe.

2.8.2 Usefulness

In the present study, knowledge of fungal communities on leaves of selected tree species in Thailand will be provided; fungal species that occur on leaves of the studied hosts are recorded; new species and new records of fungi in Thailand were

found. Denaturing gradient gel electrophoresis (DGGE) method reveal different fungal communities from leaf parts. This method allows profiling fungal communities and access phylogenetic relationships of revealed phylotypes. We also found evidence for the changes from endophytic to saprobic fungi after leaf fall. Phylogenetic relationships of *Guignardia* species and its anamorph *Phyllosticta* species were analysed using multiple DNA sequences analysis.