FINAL REPORT

(DRAFT)

COELOMYCETE FUNGI IN THAILAND: DIVERSITY AND ECOLOGY IN KHAO YAI NATIONAL PARK

(BRT R_149001)

OCTOBER 2005 – SEPTEMBER 2006

SAYANH SOMRITHIPOL

NATIONAL CENTER FOR GENETIC ENGINEERING AND BIOTECHNOLOGY (BIOTEC)

โครงการพัฒนาองค์ความรู้และศึกษานโยบายการจัดการทรัพยากรชีวภาพในประเทศไทย
c/o ศูนย์พันธุวิศวกรรมและเทคโนโลยีชีวภาพแห่งชาติ
อาคารสำนักงานพัฒนาวิทยาศาสตร์และเทคโนโลยีแห่งชาติ
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บทสรุปผู้บริหาร

เชื้อรา coelomycetes เป็นเชื้อรากลุ่มที่มีการสืบพันธุ์แบบไม่อาศัยเพศที่มีลักษณะเฉพาะ มีการศึกษาน้อย ในประเทศไทยมีการสำรวจและรายงานบันทึกเกี่ยวกับเชื้อรากลุ่มนี้น้อยด้วยเช่นกัน การศึกษาครั้งนี้มีจึงวัตถุประสงค์เพื่อทำการเก็บเชื้อรา coelomycetes และแยกเป็นเชื้อบริสุทธิ์ รวมถึงทำการศึกษาความหลากหลายและนิเวศวิทยาของเชื้อรากลุ่มนี้ในอุทยานแห่งชาติเขาใหญ่ การศึกษาในครั้งนี้หากพบเชื้อราชนิดใหม่ก็จะทำการตั้งชื่อ บรรยายลักษณะและพิมพ์รายงานในวารสารวิชาการนานาชาติต่อไป

การบ่มตัวอย่างที่เก็บมาในภาชนะที่มีความชื้นแล้วตรวจหาเชื้อราเป็นวิธีการที่ใช้ในการศึกษา การสำรวจทำในป่าดิบชื้น ป่าดิบเขา และทุ่งหญ้าในอุทยานแห่งชาติเขาใหญ่ สวนสาธารณะในกรุงเทพมหานคร พื้นที่ชุ่มน้ำในจังหวัดปทุมธานี และสวนไผ่ในจังหวัดนครนายก ช่วงเวลาที่ทำการศึกษาคือระหว่างเดือนมิถุนายน 2548 ถึงเดือนกันยายน 2549

จากตัวอย่างซากใบ กิ่ง ผลและเมล็ดพืชที่เก็บมาจำนวน 643 ตัวอย่าง พบเชื้อราที่มีการสืบพันธุ์แบบไม่อาศัยเพศ (anamorphic fungi) ทั้งสิ้น 78 ชนิด 146 สายพันธุ์ โดยเป็นกลุ่ม coelomycetes 22 ชนิด 54 สายพันธุ์ และ hyphomycetes 56 ชนิด 92 สายพันธุ์ เชื้อรา *Chaetospermum camelliae* เป็นชนิดที่พบมากที่สุด และพบกระจายอยู่ในหลายพื้นที่ สวนสาธารณะในกรุงเทพมหานคร ป่าดิบชื้น และป่าดิบเขาในอุทยานแห่งชาติเขาใหญ่เป็นพื้นที่ที่พบเชื้อรากลุ่ม coelomycetes มากกว่าที่อื่นๆ ซึ่งผลการวิเคราะห์ข้อมูลในพื้นที่ทั้ง 3 แห่งนี้พบว่าสวนสาธารณะมีความร่ำรวยของชนิดพันธุ์ (species richness) มากที่สุด ส่วนป่าดิบชื้นในอุทยานแห่งชาติเขาใหญ่มีความหลากหลายของชนิดพันธุ์ (species diversity) มากที่สุด ความคล้ายคลึงกันของชนิดพันธุ์เชื้อรากลุ่ม coelomycetes ที่อาศัยอยู่ในระบบนิเวศที่เป็นพื้นที่ป่าสองแห่ง มีมากกว่า ความคล้ายคลึงกันของชนิดพันธุ์เชื้อรากลุ่ม coelomycetes ที่อาศัยอยู่ในระบบนิเวศที่เป็นพื้นที่ป่ากับระบบนิเวศที่เป็นพื้นที่เมือง การศึกษาครั้งนี้ยังพบเชื้อราชนิดใหม่ 7 ชนิด โดยเป็นเชื้อรากลุ่ม coelomycetes 1 ชนิด ส่งผลให้เกิดบทความที่อยู่ในระหว่างการพิมพ์ในวารสารวิชาการนานาชาติ เพื่อรายงานการค้นพบเชื้อราดังกล่าว เป็นจำนวน 5 บทความ

EXECUTIVE SUMMARY

Coelomycete is a unique group of anamorphic fungi with few investigations. In Thailand they are poorly surveyed and documented. The objectives of this research are to collect the coelomycetes and isolate them into pure culture; to study their diversity and ecology in Khao Yai National Park; and to describe and publish any new species collected from the study.

Substratum incubation and direct examination for fungi were the investigation methods. The surveying sites included an evergreen forest, hill evergreen forest, and grassland in Khao Yai National Park; an urban park in Bangkok; the wetland in Pathum Thani; and the bamboo garden in Nakhon Nayok. A period of the study was between June 2005 and September 2006.

A total 643 samples of dead leaves, twigs, decaying fruits and seeds were collected and 146 anamorphic fungi (78 species), including 54 coelomycetes (22 species) and 92 hyphomycetes (56 species), were recorded. *Chaetospermum camelliae* was the most abundant coelomycete and common to a wide range of habitat. The evergreen forest and hill evergreen forest in Khao Yai National Park and the urban park in Bangkok possessed a higher record of coelomycetes than the other sites. The analysis of coelomycetes from the three sites revealed that the urban park possessed the highest species richness while the evergreen forest possessed the highest species diversity. Coelomycetes between the two natural forest habitats are more similar than those between natural forest habitat and urban habitat. Seven new fungi, including one coelomycete were also collected in the study and, consequently, five international papers to name and describe them are in a publication process.

ACKNOWLEDGEMENTS

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INTRODUCTION

Thailand locates in the tropic that supports high biological diversity reflected by a number of new taxa being described. For example, the recent study on anamorphic fungi colonizing decaying plant (fruits, seeds, leaves) has yielded a number of species new to science (Somrithipol *et al.*, 2002; Somrithipol and Jones, 2003a; 2003b, 2003c; 2005). Some collected fungi also possess the ability in producing bioactive compounds with pharmaceutical potential (Chinworrungsee, 2004; Chinworrungsee *et al.*, 2004; Pittayakhajonwut *et al.*, 2002; Sawadjoon, 2003; Sawadjoon *et al.*, 2004).

Coelomycetes are anomorphic fungi that produce asexual spores (conidia) in a flask-shaped structure (pycnidium), or in a combination structure of a fungus and host tissue (acervulus) or on a mass of vegetative hyphae (stroma)(Sutton, 1980). It is a unique group of fungi that has few experts and few investigations. Although Thailand is well known as source of high fungal diversity, coelomycetes are poorly surveyed and documented. Most of their records belong to the plant pathogenic species (Giatgong, 1980).

Recent studies on coelomycetes colonizing decaying plant in natural forests are based on diversity, taxonomy, and screening. Somrithipol *et al.* (2001) contributed a preliminary survey on saprophytic coelomycetes in urban parks and natural forests and deposited *ca* 50 isolates in BIOTEC Culture Collection. Most of them were new to the principality. Seephonkai *et al.* (2002) evaluated antimycobacterial and antiplasmordial activities of preussomerins isolated from the coelomycete *Microsphaeropsis* species. Plaingam *et al.* (2003; 2005) described and published two new coelomycete species from Thailand: *Infundibulomyces cupulata* and *Pseudorobillarda siamensis*. These results indicate that there are many coelomycetous species in the Thai forests waiting to be discovered and tested for their bioactive property. An intensive study on the taxonomy and diversity of coelomycetes is, therefore, required to complete the biodiversity knowledge of the country, and to yield their cultures for future utilization.

OBJECTIVES

The objectives of this study are:

1. To collect coelomycete and deposit in the BIOTEC Bangkok Herbarium,
2. To isolate coelomycete into pure culture and deposit in BIOTEC Culture Collection,
3. To study the ecology of coelomycetes in selected sites,
4. To describe and publish any new fungi encountered during the study.

SCOPE OF THE STUDY

1. Coelomycetes were mainly collected while hyphomycetes were also recorded for a comparison.
2. Khao Yai National Park was mainly surveyed while other sites were also investigated for the fungal diversity comparison.
3. Incubation and direct examination for fungal fruiting structures of collected materials were the investigation methods.

LITERATURE REVIEWS

1. Definition of Coelomycetes

Coelomycetes are anamorphic fungi producing asexual spores (conidia) within globose or flask-shaped structures (pycnidia), shield-shaped, or hemispherical structures (pycnothyrium), in a combination structure of fungus and host tissue (acervulus), or on a mass of vegetative hyphae (stroma) (Sutton, 1980; Nag Raj, 1993).

2. Classifications of Coelomycetes

The ideal suprageneric classification for deuteromycetes (Fungi imperfecti or anamorphic fungi including agonomycetes, coelomycetes and hyphomycetes) are based on their recognized sexual stage (teleomorphs). In most cases, however, the teleomorphs are not known, so the separating taxa above the generic level were forced to use the artificial systems (Sutton, 1980).

Gerera of pycnidial and acervular fungi used to be classified in the orders of Uredinales, Sphaeriales, Moniliales, and even in the class Gasteromycetes, until Saccardo had fully clarified their relationships with other groups (Sutton, 1973). Saccardo proposed the morphological system in classification of Fungi Imperfecti, which taking into two main accounts: 1) the mode of grouping of conidial apparatus; and 2) the colour, form, and septation of the produced spores (Kiffer and Morelet, 2000).

Grove (1935) was firstly proposed the name 'Coelomycetes' for 'Deuteromycetes which bear their spores within some cavity of the matrix on which they grow'. He divided them into two orders: 1) Sphaeropsidales which spores are produced in a cavity that surrounded by a special structure of mycelium called pycnidium; and 2) Melanconiales which spores are produced on a mycelia pustule at the bottom of the cavity while other part of the cavity surrounded by host tissues. Sphaeropsidales was subdivided into four families: Sphaeroideae, Nectrioideae, Excipulaceae, and Leptostromataceae. Sphaeroideae and Nectrioideae possess completely rounded pycnidia but pycnidia of the former are dark while those of the latter are hyaline or bright. Excipulaceae and Leptostromataceae possess incompletely rounded pycnidia but pycnidia of the former lose the upper part when mature while those of the latter composed of the upper part only (Grove, 1935).

The Saccardoi system, however, losses the confidence when the colour of conidia and the grouping of conidiophores are taken into consideration. Hughes (1953),

therefore, classified Hyphomycetes into eight sections based on types of conidiophore and conidium development: IA- Blastosporae; IB- Botryo-Blastosporae; II- Sympodulosporae; III- Aleuriosporae, Annellosporae; IV- Phialosporae; V- Meristem Arthrosporae; VI- Porosporae; VII- Arthrosporae, and VIII- Meristem Blastosporae.

Sutton (1971) accepted the two orders proposed by Grove (1935) and adopted Hughes's classification. He mentioned that the majority of coelomycete genera showed annellidic (III) and phialidic (IV) ontogeny and none coelomycetes possessed ontogeny of the sections VI and VIII. He also proposed the priority work to analysis the conidial development in many undetermined genera.

Sutton (1973) gave a taxonomic review of Coelomycetes and provided a key to 53 genera of Melanconiales and 146 genera of Sphaeropsidales. Fernando *et al.* (1979) provided a synoptic key to 200 genera of coelomycetes, which their descriptions and illustrations were published in the 'Icones generum coelomycetum' fasicle I (Morgan-Jones *et al.*, 1972) to fascicle XIII (Nag Raj and DiCosmo, 1982).

Sutton (1980) provided the descriptions of 372 coelomycete genera with a number of illustrations. He also proposed a classification scheme for a whole Deuteromycota, using the difference in conidiogenesis to separate them at class and order levels and using the difference in conidiomatal structures to separate them at the family level. The Deuteromycota was divided into two classes based on thallic and blastic ontogeny: Thallodeuteromycetes and Blastodeuteromycetes. Each class was subdivided into two subclasses based on the conidial wall origin (hologenous or enterogenous), resulting totally four subclasses: Holothallomycetidae, Enterothallomycetidae, Holoblasto-mycetidae, and Enteroblastomycetidae. The three former subclasses accommodate a single order (Thallales, Enterothallales and Blastales, respectively) while the latter subclass accommodates two orders (Phialidales and Tretales). The families of coelomycetes in the orders Thallales, Blastales and Phialidales were separated by pycnidial, pycnothyrial, or stromatic conidiomata while the orders Enterothallales and Tretales accommodate none coelomycete (Sutton, 1980).

Nag Raj (1993) provided the description and illustration of 417 species in 142 genera of coelomycetes with appendaged conidia.

Kiffer and Morelet (2000) divided deuteromycetes into 13 groups or sections: Artrosporae, Meristem Artrosporae, Aleuriosporae, Annellophorae, Sympodulosporae, Acroblastosporae, Botryoblastosporae, Porosporae, Phialosporae, Annellidae, basauxic deuteromycetes, and mycelia sterilia. These sections belong to two orders: 1) Hyphales which conidiophores are free, and 2) Conidiomatales which conidiophores are grouped into conidiomata (coremia, sporodochia, acervuli, pycnidia, pseudopycnidia, thyriopycnidia and cupules). In each section, Kiffer and Morelet (2000) provided keys to genera and line drawings of each genus.

In the latest edition of the Dictionary of the Fungi, Kirk *et al.* (2001) quoted the traditional separation of coelomycetes as the following:

(1) *Melanconiales*. Mycelium within the host or substratum. Conidiogenous events are various. Conidiomata are subcuticular, epidermal, subepidermal, peridermal, or subperidermal and the conidiogenous layer is form within the substratum. Dehiscence is by rupture of the overlying tissues and conidial masses may be dry or slimy. Conidiomata become erumpent at maturity and grade into sporodochial conidiomata (tuberculariaceous hyphomycetes). In culture such fungi cannot be distinguished from many hyphomycetes.

(2) *Sphaeropsidales* (Phomales, Phyllostictales). Mycelium may be immersed in the substratum or superficial. Conidia may be dry or slimy and conidiogenous events are various. Conidiomata are superficial, semi-immersed or immersed with the conidiogenous layer lining the walls of the locule(s). Diversity in conidiomatal structure is considerable in terms of tissue composition, number and arrangement of locules, relationship to the substrata and type of dehiscence.

(3) *Pycnothyriales* Mycelium may be immersed in the substratum or superficial; when superficial it may bear hyphopodia and/or setae. Conidia are produced in several way. Conidiomata are superficial or subcuticular, flattened, uni- or multi-locular, sometimes attached to the substratum by a central column of tissue or hypostroma, otherwise attached at the periphery; conidiogenous layer may be restricted to the upper or lower surface or occur on both; tissue structure of the pycnothyrium and nature of marginal cells are important generic criteria. Anamorph of Dothideales.

3. Importance of Coelomycetes

Kirk *et al.* (2001) estimated *ca* 1000 genera and 7000 species of coelomycetes worldwide. They have been recovered from the widest range of ecological niches. Coelomycetes play an important role in terrestrial ecosystems: as saprobes, or parasites of higher plants, fungi, lichens, vertebrates (Kirk *et al.*, 2001). Some coelomycetes have important commercial benefits, such as *Colletotrichum gloeosporioides*, whose spores are marketed under the trade name "Collego" and used successfully to control northern joint vetch in America (Alexopoulos *et al.*, 1996). *Pestalotiopsis microspora*, *Pestalotiopsis* sp., and *Phomopsis* sp. have potential anti-cancer properties (Kathiravan and Muthumary, 2000; Lam *et al.*, 2000; Li *et al.*, 1998).

4. Thai Coelomycetes

Records of coelomycetes in Thailand are primarily of plant pathogenic species, that cause leaf spots, leaf blight, twig blight, anthracnose, leaf rot, stem rot, fruit rot and die back of various commercial crops (Giatgong, 1980). Based on data from Sontirat *et al.* (1994), 380 collections of pathogenic coelomycetes have been recorded for Thailand. The most common genera are *Colletotrichum* (on a variety of hosts, but especially *Capsicum annum*), *Gloeosporium* (anthracnose and fruit rot of various plants), *Diplodia* (root-rot of a variety of taxa), *Phyllosticta* (wide range of species causing leaf spot of a number of plants), and *Pestalotia* (leaf spots of a variety of taxa) (Plaingam *et al.*, 2004). Sontirat (1991) and Sontirat *et al.* (1991) have also reported a number of coelomycetes causing disease of plants in Thailand e.g. *Colletotrichum capsaci*, *C. caudatum*, *C. gloeosporioides*, *C. truncatum*, *Colletotrichum* sp., and *Pestalotiopsis* spp. (at least six species, as leaf spots of various plants). While there are numerous reports of

coelomycetes in agriculture, comparatively little is known of their occurrence on wild plants as parasites, saprobes and endophytes. In a preliminary study, Plaingam (2002) collected and identified 40 species collected on leaves, twigs and fruits in native forests in Thailand. The most common taxa encountered are *Chaetospermum camelliae* and *Pseudorobillarda sojae* (Plaingam *et al.*, 2004).

Plaingam (2002) studied and reported the conidial and conidial appendage ontogeny of *Chaetospermum camelliae*, *Pestalotiopsis* sp., *Pseudorobillarda sojae*, *Coniella castaneicola, and Xepicular leucotricha* at the Transmission and Scanning Electron Microscope levels. The study revealed that the conidial wall of *Chaetospermum camelliae*, *Pestalotiopsis* sp., *Xepicula leucotricha*, *Pseudorobillarda sojae* and *Coniella castaneicola* consists of two layers: (i) a thin electron-dense outer layer and (ii) an inner thicker less electron-dense layer. However, conidial wall thickness and conidial appendage ontogeny varies between the genera. In *C. camelliae*, the outer wall gives rise to the appendage, while the inner layer delimits the appendages from the conidium at maturity. In *Pestalotiopsis* sp., polar appendages are formed synchronously as outgrowths of the inner and outer wall layers of the conidium cell wall. A single basal appendage was formed later by extension of an inner conidial cell wall. In *Xepicula leucotricha*, the thin-outer wall layer contributed to the funnel shaped apical mucoid appendage. The wall of the conidiogenous cell of *Pseudorobillarda sojae*, forms a continuous sheath around the developing conidium. Appendages originate from the apex of the conidium as an outgrowth of the outer conidial wall and subsequently freed from the sheath by rupture or dissolution of the tip of the sheath. In *Coniella castaneicola*, the conidium is initially enveloped by a sheath. Subsequently, a fissure forms on one side of the conidium and the sheath fragments accumulate on one side of the conidium to form the appendage (Plaingam, 2002).

MATERIALS AND METHODS

1. Surveying Sites

The previous studies have shown that a few collection sites of Khao Yai National Park can yield a rich mycota (Somrithipol *et al.*, 2002b) and a number of new species including coelomycetes (Somrithipol and Jones, 2003a; 2003b; Plaingam *et al.*, 2003; 2005). This study will mainly investigate in Khao Yai National Park at Mo Singto Permanent Plot. The total size of Mo Singto Permanent Plot is 714 quadrates (each 20×20 m) in an area 500×600 m, for a total of 28.6 hectares (Brockelman *et al.*, 2001). Surveying sites in other National Parks and urban parks will be additional for documentation of coelomycete diversity.

2. Material Collecting

Various fallen and/or decaying plant materials such as leaves, twigs, fruits and seeds of a variety of tree species on the forest floor will be randomly collected, placed in plastic bags and returned to the laboratory. Materials will be identified to plant species. General hints on collecting coelomycetes are described by Sutton (1980) and Nag Raj (1993).

3. Material Examining

Collected materials will be examined directly under a dissection microscope to determine if any fungal fruiting structures present. The areas with fruiting structures will be marked with a distinctive colour pin. Material without fungal appearance will be washed with water before incubated in moist chambers at 20°C and periodically examined for emergence of fungal fruiting structures.

Colonizing coelomycetes offer some visible clues, such as: papillate ostioles or rostrate necks protruding beyond the substrata, conidial masses spreading over the substrata, or conidial cirrhi of varying colour (Nag Raj, 1993). Encountering coelomycetes will be cut open with a sharp blade and the inside contents removed to mount in water on a glass slide. Squash mounts of these contents offer well-separated conidiogenous cells. Free hand sections or sections using a freezing microtome well provide the situation of conidiogenous cells and characters of conidiomal wall layers. Slides are observed and photographed under a Nomarski Differential Interference Contrast microscope. Measurements and drawings will do under a compound microscope with camera lucida. Measurements include minimum-maximum ranges and the aristhmetic mean ($\bar{x}$) with ± standard deviation for n measured units. A minimum n is 50 for conidia, 25 for conidiogenous cells, and 10 for conidiomata if materials are sufficient.

Other details on examination of coelomycetes have been provided in the details by Fernando *et al.* (1979), Nag Raj (1993), and Sutton (1980).

4. Identification

4.1 Principles

Morphological characteristics are basic for identification. The principle of identification is based on Hughes's conidiogenesis and the Saccardoi system.

4.2 General Characteristics for Identification and Description

The following accounts given by Sutton (1973) are guideline for identification and description:

'Fructifications, when superficial or partly immersed, may be subtended by vegetative unspecialized ramifying hyphae or by hyphae arranged in subicula and anastomosing or radiating networks. *Pycnidia* are superficial or immersed; spherical flattened or discoid; with a multicellular wall of isodiametric cells; pigmented yellow, orange, brown to black; separate or aggregated; usually with a dishiscent opening (ostiole). *Acervuli* are immersed, separate or confluent; consisting of a basal stroma lacking lateral and upper walls or specialized methods of dehiscense. *Stromata* may be convoluted, uni- or multi-locular, superficial or immersed of various shapes, with thick, multicellular walls of isodiametric cells, pigmented yellow, orange, brown or black, separate or aggregated, and with one or more dehiscent ostioles. *Conidiogenous cells* are form on the inner face of the fructification walls, sometimes restricted to the lateral or basal walls, unicellular, often grouped into complex structures (conidiophores) producing conidia asexually. *Conidia* are enterothallic, holothallic, enteroblastic or holoblastic, phialides and annellides being most common, deciduous, hyaline or pigmented, aseptate, euseptate, or distodeptate, of various shapes, and with cellular or extracellular appendages, setulae, and mucilaginous ornamentations' (Sutton, 1973).

4.3 Important Literatures

The following textbooks are used for identification and description of coelomycetes: Grove (1935, 1937), Sutton (1973, 1980), and Nag Raj (1993). The serial papers 'General coelomycetarum' published in Canadia Journal of Botany (e.g.: Nag Raj and Kendrick, 1971) and 'Icones generum coelomycetum' in the University of Waterloo Biology Series (e.g.: Fernando *et al.*, 1979) are also important literatures for coelomycete taxonomy. Other knowledge of this taxonomic group will be updated from papers in the following journals: Fungal Diversity, Nova Hedwigia, Mycologia, Mycological Research, Mycoscience, Mycotaxon, and Sydowia.

5. Preservation of the Specimens

After examination, substrata with colonizing coelomycetes will be dried down and deposit in the BIOTEC herbarium (BBH). Floral and foliar samples is pressing and drying that similar to those of botanical specimens while twigs, stems or bark are best air-dried (Nag Raj, 1993). Examined slides will be preserved by replacing the mounting water with lactophenol and sealing the coverslip with polyvinyl alcohol, before labeled, placed in slide boxes and kept at Mycology Laboratory. Colonizing substrata are primary herbaria

specimens. If the substrata are depleted during the examination, slides will be served as specimen of the fungus (Hawksworth, 1974).

6. Isolation and Culture Preservation

Fruiting bodies of coelomycetes will be picked up, transferred into a drop of sterile water on a sterile glass slide, and then crushed to release their conidia. The conidial suspension will be checked under a compound microscope at low magnificent to ensure the identity before transferred with a loop to streak on the media (Corn Meal Agar with 0.5 mg/L streptomycin sulfate). Conidia on the media will be incubated at 25°C for 24-48 hour and periodically checked under a dissection microscope for germination. If the germination success, a small plug of agar with the germinated conidia will be picked up and transferred to another CMA media plate, at least 5-10 isolates of each species to ensure that these isolates are the same species. Pure isolates will be finally transferred to grow on PDA (Potato Dextrose Agar) before cut into small cubes (*ca.* 0.5 cm) and put in cryotubes with 5% glycerol and storage at -196°C at BIOTEC Culture Collection.

7. Data Analyses

The importance of each fungal taxa will be determined using the relative species abundance and frequency of occurrence. The fungal information of the study sites/plots will be presented in terms of species lists, species diversity, species evenness, species richness and fungal distribution pattern. A fungal comparison between two sites or two communities will use the index of similarity. Analysis of environmental and fungal relationships will use the ordination technique.

7.1 Relative Species Abundance

The relative species abundance (A) is the presence of individuals of the given species compare to all species individuals. Ho *et al.* (2002) and Yanna *et al.* (2002) regarded a fungus with species abundance >10% as a dominant species

$$\mathbf{A = \frac{individual\ of\ a\ given\ species}{individual\ of\ all\ species} \times 100}$$

An individual refers to one colony.

7.2 Frequency of Occurrence

Frequency of occurrence (F) is a chance of finding the given species from a particular trial sample.

$$\mathbf{F = \frac{number\ of\ sample\ with\ the\ given\ species\ occur}{number\ of\ total\ sample} \times 100}$$

7.3 Species Diversity

Species diversity of fungi in each site was calculated by the Shannon-Weaver Index (H′) (Shannon and Weaver, 1949).

$$H' = -\sum_{i=1}^{n} p_i \log_2 p_i$$

Where p_i = number of individuals of each species/ number of individuals of all species, n = total number of species

7.4 Species Evenness

Fungal evenness in each collection site will be calculated using the species evenness index (E) (Pielou, 1969).

$$E = H' / \log_2 S$$

Where H′ = Shannon-Weaver Index of species diversity,
S = total number of species

7.5 Richness Index

The richness index will be calculated in the form of richness index 1 (R_1)(Margalef, 1958) and richness index 2 (R_2) or Menhinick's index (Menhinick, 1964).

$$R_1 = S-1 / \ln (N)$$
$$R_2 = S / \sqrt{N}$$

Where S = total number of species,
N = total number of individuals of all species

7.6 Index of Similarity

Fungal similarity between two collection sites will be calculated by the Similarity Index of Sørensen (IS)

$$IS = 2C/(A+B) \times 100$$

Where A = number of species occurring in the first site,
B = number of species occurring in the second site
C = number of species occurring in both sites.

RESULTS AND DISCUSSION

1. Surveys and Sample Collecting

A total of 643 samples of fallen leaves, twigs, fruits and seeds were collected from six habitats (urban forest, hill evergreen forest, evergreen forest, wetland, grassland, and bamboo garden) in four localities. Details of the collected samples are in Table 1.

Table 1. Type and number of samples collected from different habitats.

Type of sample	Number of samples						
	UF	HEF	EF	W	BG	G	Total
Dead leaves	120	130	243	20	20	20	310
Dead fruits and seeds	-	-	60	-	-	-	20
Dead twigs	-	30	-	-	-	-	10
Total	**120**	**160**	**303**	**20**	**20**	**20**	**643**

Remark UF = Urban Forest, Chatuchak, Bangkok; W = Wetland, Pathum Thani; HEF= Hill Evergreen Forest, Khao Yai Nat. Park; BG = Bamboo Garden, Nakhon Nayok; EF = Evergreen Forest, Khao Yai Nat. Park; G = Grassland, Khao Yai Nat. Park.

2. Diversity of Coelomycetes on the Collected Samples

As the anamorphic fungi comprise two main groups: hyphomycetes and coelomycetes, hyphomycetes were also recorded from these samples for a comparison. The examination has yielded 146 anamorphic fungi (78 species) including 54 coelomycetes (22 species) and 92 hyphomycetes (56 species) (Appendix Table 1, 2). In Khao Yai National Park, 33 coelomycetes (13 species) have been collected.

The balance ratio of collected coelomycetes to hyphomycetes should be 1/1.3 (Table 2). The ratio of 1/2.5 from this study indicates that fewer coelomycetes have been collected. Various factors affecting coelomycete colonization such as collection site, substratum quality, weather and other environmental conditions.

Table 2. Number of coelomycete and hyphomycete and their ratio from the present study and the world record

	Number of species		Ratio of coelomycetes to hyphomycetes
	Coelomycetes	Hyphomycetes	
Total species (Kirk *et al.*, 2001)	7,000	9,000	1/1.3
Species collected in this study	22 (0.31%)	56 (0.62%)	1/2.5

3. Ecological Analysis of the Coelomycetes Collected

The coelomycete data from urban forest, evergreen forest and hill evergreen forest were ecologically analyzed. The data from wetland, bamboo garden, and grassland were discarded because few coelomycetes have been collected from these habitats.

The importance of each coelomycete taxon in term of species abundance (A) and frequency of occurrence (F) is shown in Table 3. *Chaetospermum camelliae* was the most abundant species (25.5%) with the highest frequency of occurrence (2.2%). *Pestalotiopsis* species, *Pseudorobillarda sojae*, and *Satchmopsis brasiliensis* were encountered with lower percentage of abundance (11.8, 7.8, and 5.9, respectively). Other coelomycete species are recorded with 3.9% (17 species) and 2.0% abundance (11 species) (Figure 1).

Chaetospermum camelliae and *Pseudorobillarda sojae* are common to the three collecting habitats while *Pestalotiopsis* species and *Satchmopsis brasiliensis* are common to the two habitats. Other coelomycetes are recorded from one collecting habitat.

The results show that urban forest possesses the highest richness of coelomycete species while the species richness of hill evergreen forest is the lowest. However, evergreen forest possesses the highest diversity of coelomycetes than other habitats. The reason is from the higher number of collected samples and, consequently, a higher number of individual encounters.

The similarities of coelomycetes between the two habitats range between 22 and 38% (Table 4). Coelomycetes between the two natural forest habitats (evergreen forest and hill evergreen forest) are more similar than those between the forest habitat and the urban habitat (Figure 2).

Table 3. List of coelomycetes, their individual (I), frequencies (F) and abundance (A) from each habitat and from all habitats

No.	Coelomycete fungi	UF			HEF			EF			Total		
		I	F	A	I	F	A	I	F	A	I	F	A
1	*Bartalinia robillardoides*	2	1.7	11.1	-	-	-	-	-	-	2	0.3	3.9
2	*Chaetomella raphigera*	1	0.8	5.6	-	-	-	-	-	-	1	0.2	2.0
3	*Chaetospermum artocarpi*	-	-	-	1	0.6	10.0	-	-	-	1	0.2	2.0
4	*Chaetospermum camelliae*	2	1.7	11.1	4	2.5	40.0	7	2.3	30.4	13	2.2	25.5
5	*Coniella castaneicola*	2	1.7	11.1	-	-	-	-	-	-	2	0.3	3.9
6	*Dinemasporium lanatum*	-	-	-	-	-	-	2	0.7	8.7	2	0.3	3.9
7	*Diplodia* sp.	-	-	-	1	0.6	10.0	-	-	-	1	0.2	2.0
8	*Lasiodiplodia theobromae*	1	0.8	5.6	-	-	-	-	-	-	1	0.2	2.0
9	*Mycotribulus mirabilis*	1	0.8	5.6	-	-	-	-	-	-	1	0.2	2.0
10	*Pestalotiopsis* sp.	3	2.5	16.7	-	-	-	3	1.0	13.0	6	1.0	11.8
11	*Phoma* sp.	2	1.7	11.1	-	-	-	-	-	-	2	0.3	3.9
12	*Phomopsis* sp.	-	-	-	-	-	-	2	0.7	8.7	2	0.3	3.9
13	*Pseudorobillarda sojae*	1	0.8	5.6	1	0.6	10.0	2	0.7	8.7	4	0.7	7.8
14	*Robillarda* sp.	1	0.8	5.6	-	-	-	-	-	-	1	0.2	2.0
15	*Satchmopsis brasiliensis*	-	-	-	1	0.6	10.0	2	0.7	8.7	3	0.5	5.9
16	*Xepicular* sp.	1	0.8	5.6	-	-	-	-	-	-	1	0.2	2.0
17	*Vermiculariopsella* sp.	-	-	-	2	1.3	20.0	-	-	-	2	0.3	3.9
18	Unidentified sp. 2	1	0.8	5.6	-	-	-	-	-	-	1	0.2	2.0
19	Unidentified sp. 3	-	-	-	-	-	-	2	0.7	8.7	2	0.3	3.9
20	Unidentified sp. 4	-	-	-	-	-	-	1	0.3	4.3	1	0.2	2.0
21	Unidentified sp. 5	-	-	-	-	-	-	1	0.3	4.3	1	0.2	2.0
22	Unidentified sp. 17	-	-	-	-	-	-	1	0.3	4.3	1	0.2	2.0

Remark: UF = Urban Forest, HEF = Hill Evergreen Forest, EF = Evergreen Forest,
I = Number of individual, F = Frequency of occurrence (%), A = Species abundance (%)

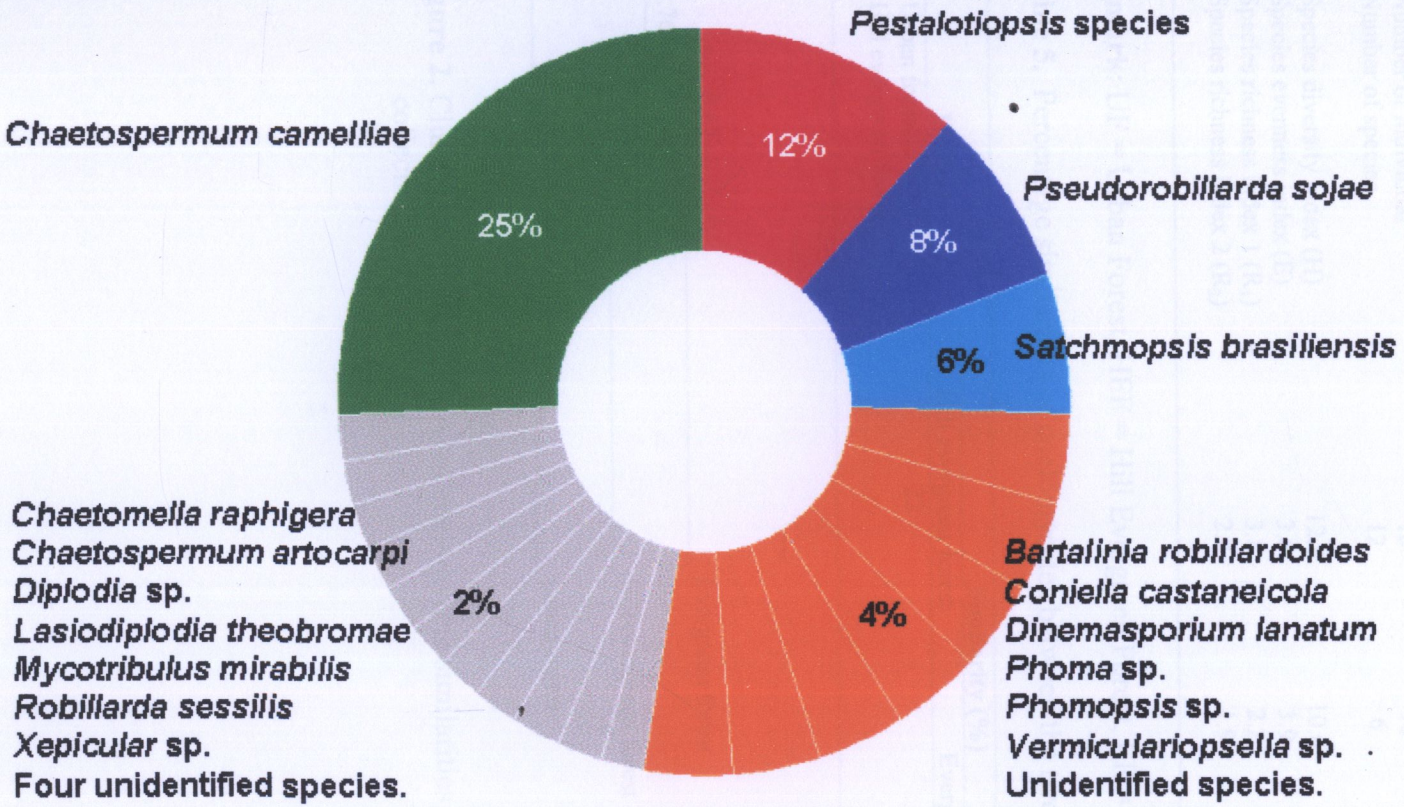

Figure 1. Abundance of coelomycetes collected from the three habitats

Table 4. The coelomycete information of each habitat.

	UF	HEF	EF
Number of samples	120	160	303
Number of individual	18	10	23
Number of species	12	6	11
Species diversity index (H)	12.8	10.0	34.4
Species evenness index (E)	3.6	3.9	9.9
Species richness index 1 (R_1)	3.8	2.2	3.2
Species richness index 2 (R_2)	2.8	1.9	2.3

Remark: UF = Urban Forest, HEF = Hill Evergreen Forest, EF = Evergreen Forest

Table 5. Percentage similarities of coelomycetes between the two habitats

	Similarity (%)	
Habitat	Hill evergreen forest	Evergreen forest
Urban forest	22	27
Hill evergreen forest		38

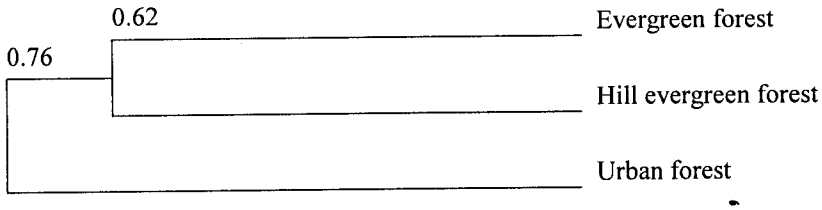

Figure 2. Cluster diagram (UPGMA) of coelomycete similarities from the three collecting habitats.

4. New Fungi Collected from the Present Study

Seven collected species including 1 coelomycete and 6 hyphomycetes are considered as new species. One of them has been published (Somrithipol and Jones, 2006); three are in a publication process (Somrithipol and Jones, 2007; Somrithipol *et al.*, 2007); and three are in manuscript preparation. The analysis shows that 11% of the total collected species are new taxa indicating a number of fungi in Thailand are waiting to be discovered.

The new coelomycete taxon possesses the distinguished characteristics in having pycnothyrial conidiomata with spiny edge (Figure 3) and holoblastic conidia (Figures 4) with an extracellular appendage (Figure 5). The fungus is most similar to species of the genus *Tubakia* but it cannot be classified in this genus because of the holoblastic conidia. The new genus is, therefore, being proposed and this fungus will be described and published as a new species.

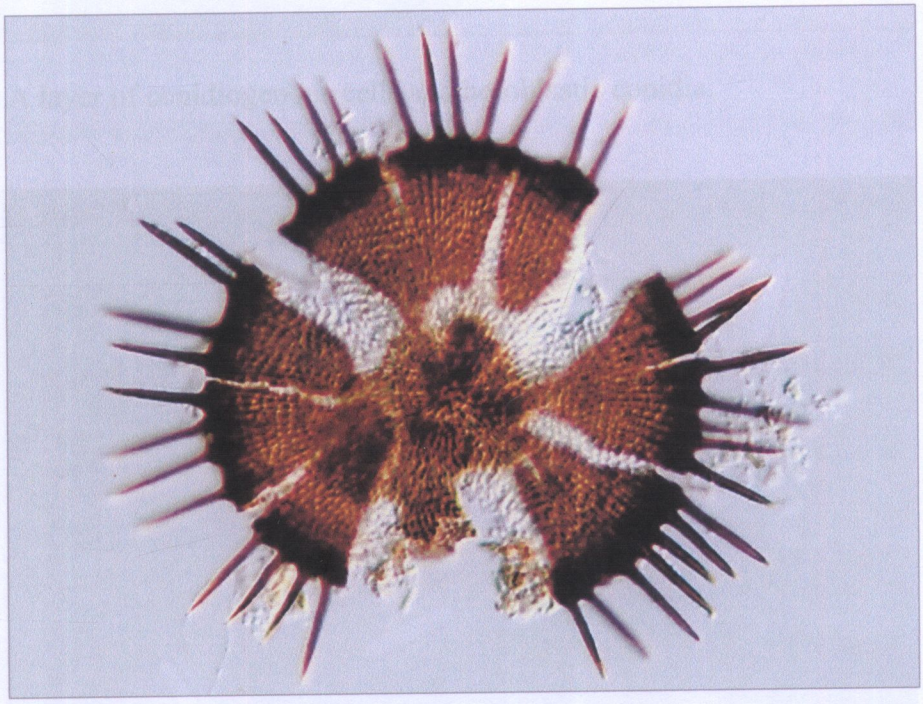

Figure 3. A pycnothyrial conidioma with spiny edge

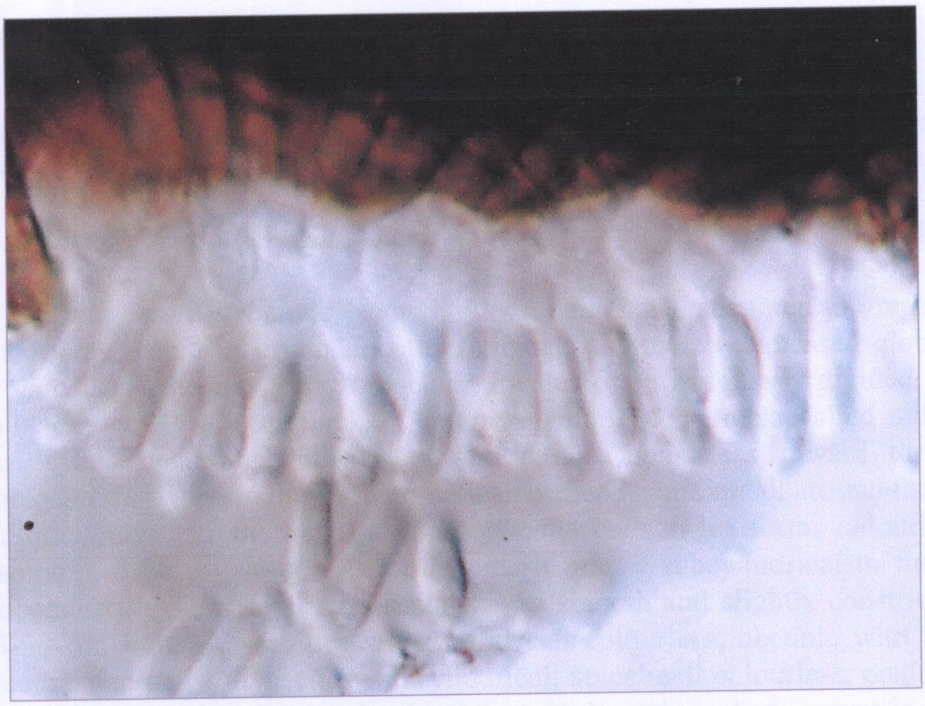

Figure 4. A layer of conidiogenous cells and holoblastic conidia.

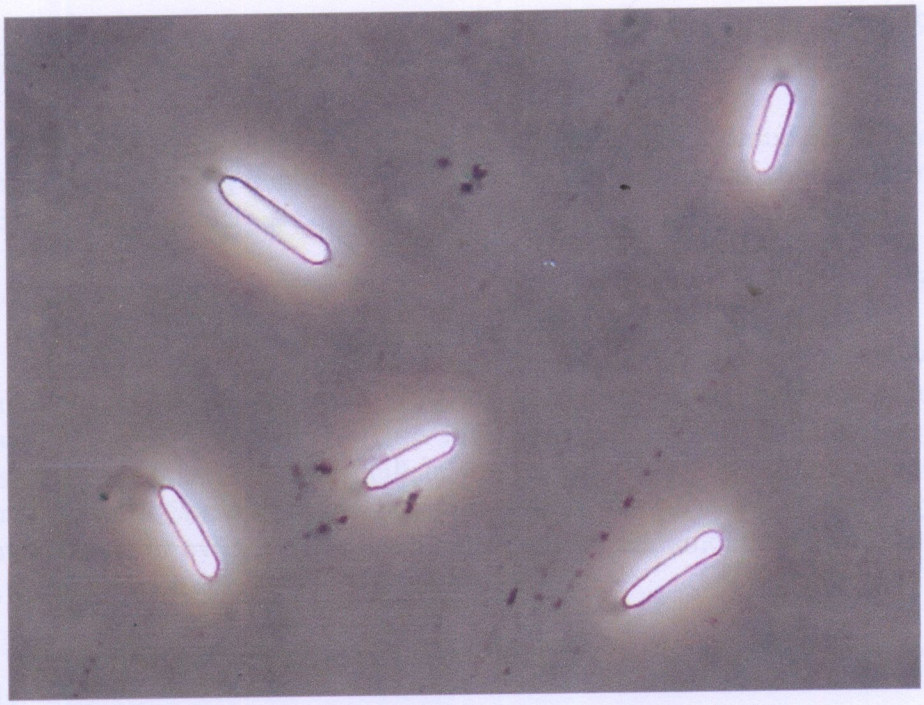

Figure 5. Conidia with an extracellular appendage.

5. Descriptions and Illustrations of the Identified Coelomycetes

All identified coelomycetes are described and illustrated in alphabetically order. Keys to species were added to the genera that have been collected more than one species.

5.1 *Bartalinia robillardoides* Tassi (Figure 6)

Conidiomata stromatic, pycnidioid, amphigenous, scattered to gregarious and confluent, subepidermal in origin, innate erumpent, globose to depressed globose, 130-280 μm wide, 100-230 μm deep, unilocular, locules often irregularly divided, glabrous, brown to black; wall 20-40 μm thick, of textura angularis, cells thick-walled and brown in the outer layers, becoming thin-walled and almost colourless toward the conidial hymenium. *Conidiophores* reduced to conidiogenous cells, arising all around the cavity of the conidioma, invested in mucus. *Conidiogenous cells* lageniform, colourless, thin-walled, smooth, 5-10 μm long, 3-3.5 μm wide. *Conidia* subcylindrical to fusiform, 4-septate, occasionally 3-, and rarely 5-septate, wall smooth and slightly constricted at the septa, 23-33 μm long, 3.5-4.5 μm wide; basal cell colourless, obconic with a truncate base; three median cells olivaceous, subcylindrical; apical cell colourless, conical, drawn out into an appendage; basal appendage cellular, single, unbranched, excentric, 2.5-5 μm long; apical appendage cellular, single, three divergent branches, 13-22 μm long; mean conidium length/width ratio 7.4/1.

Specimens and cultures examined: SFC 1917 (BCC 18599), SFC 1921 (BCC 18600) (Appendix Table 1. for details).

Conidial morphology is a distinctive character of the genus *Bartalinia*. Species are distinguished by using conidial measurements and number of conidial septum (Nag Raj, 1993).

5.2 *Chaetomella raphigera* Swift (Figure 7)

Conidiomata pycnidial with single longitudinal ostiole, stipitate with short stalk, unilocular, 100-200 μm high, 150-450 μm wide. *Setae* cylindrical to clavate, brown, smooth, septate, up to 150 μm high, 2-6 μm wide. *Conidiophores* filiform, smooth, septate, hyaline, branch verticillately or irregularly, arising from the inner cells of the pycnidial wall. *Conidiogenous cells* integrated, terminal, polyblastic, sympodial, denticulate, clavate or cylindrical. *Conidia* allantoid, 1-cell, smooth-walled, hyaline, 7-10 μm long, 1.5-2 μm wide.

Specimen and culture examined: SFC 1919 (BCC 18528) (Appendix Table 1. for details)

Morphology of conidioma is a distinctive character of the genus *Chaetomella*. *Chaetomella raphigera* is distinguished by coil or clavate shape of seta apices (Sutton and Sarbhoy, 1976; Sutton, 1980).

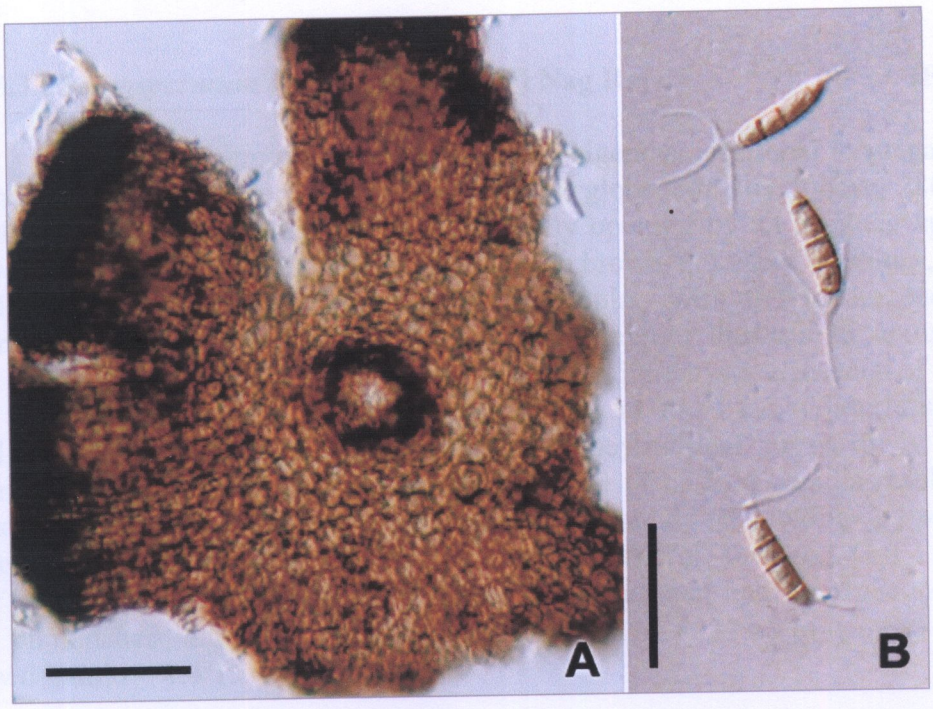

Figure 6. *Bartalinia robillardoides*: **A,** squash mount of a pycnidial conidioma with an ostiole (bar = 100 µm); **B,** conidia with an apical, 3-branched appendage and a basal appendage (bar = 30 µm).

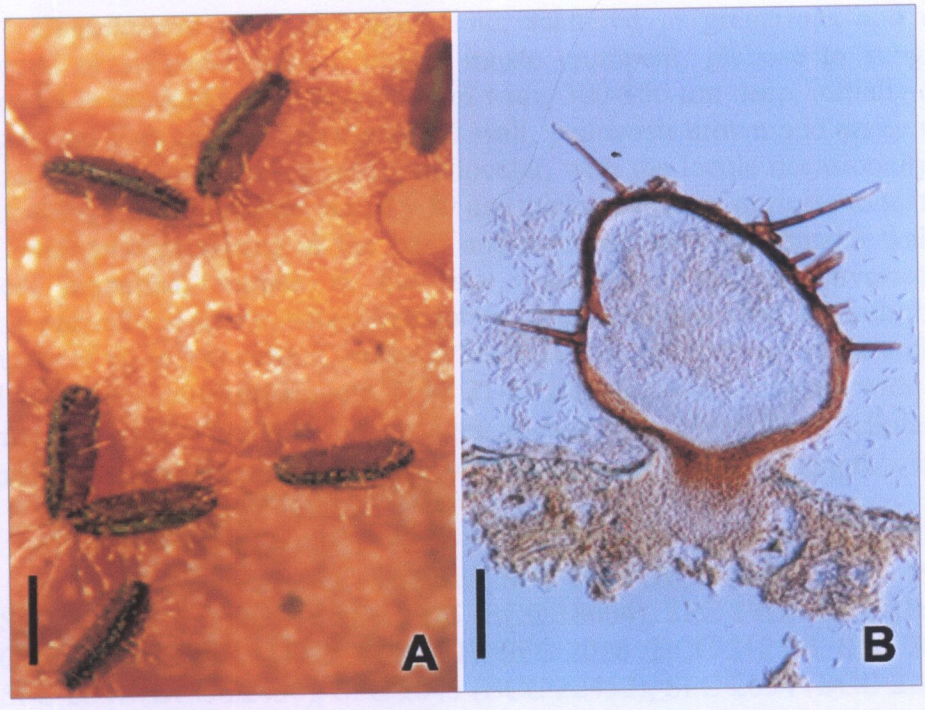

Figure 7. *Chaetomella raphigera*: **A,** pycnidial conidiomata on a natural substratum (bar = 400 µm); **B,** vertical section of a conidioma showing a stalk and setae (bar = 150 µm).

5.3 *Chaetospermum artocarpi* (Nag Raj) Nag Raj (Figure 8)

Conidiomata stromatic, pycnidioid, amphigenous, scattered to gregarious and confluent, subepidermal in origin, innate erumpent, globose to subglobose, 280-630 µm wide, 140-310 µm deep, initially closed, ultimately opening by an irregular split in the apical wall, salmon pink or flesh colour to yellowish brown and waxy when dry, off white or pearl white and gelatinous when moist, unilocular, with the locule occasionally irregular divided or convoluted, glabrous; wall of textura intricata to textura oblita, heavily gelatinized. *Conidiophores* arising from the innermost elements of the wall, loosely aggregated, sparingly branched and septate at the base, colourless, smooth, invested in gel. *Conidiogenous cells* discrete, subcylindrical to narrowly conic or irregular, colourless, smooth, bearing an apical cluster of up to 4 conidia resulting from holoblastic-sympodial proliferations. *Conidia* ellipsoidal to oblong ellipsoidal or cylindrical with obtuse ends, colourless, smooth, 18-26 (-27.5) µm long, (4-) 4.5-5.5 µm wide ($\bar{x}$ = 22 × 5 µm), bearing 3 polar appendages at each end; appendages cellular, tubular, unbranched, attenuated, flexuous, (8-) 9.5-15 ($\bar{x}$ = 13.5) µm; mean conidium length/width ratio = 4.4/1.

Specimen and culture examined: SFC 1904 (BCC 18581) (Appendix Table 1. for details).

5.4 *Chaetospermum camelliae* Agnihothr. (Figure 9)

Conidiomata stromatic, pycnidioid, scattered to gregarious and confluent, subepidermal or subperidermal in origin, innate erumpent, globose to subglobose or hemispherical in sectional view, 450-500 µm wide, 300-350 µm deep, initially closed but dehiscing by an irregular split in the apical wall, yellowish brown and waxy when dry, pearl white and gelatinous when moist, unilocular, with the locule occasionally irregular divided or convoluted, glabrous; wall 25-50 µm thick, of textura intricata to textura oblita in gel. *Conidiophores* arising at the base and sides of the conidiomatal wall, loosely aggregated, branched, septate at the base, colourless, smooth, invested in gel. *Conidiogenous cells* discrete, subcylindrical or irregular, colourless, smooth, bearing an apical cluster of up to 3 conidia. *Conidia* cylindrical with rounded or obtuse ends, straight or slightly curved, colourless, smooth, (19-) 21-29 µm long, 4-5 (-5.5) µm wide ($\bar{x}$ = 24.8 × 4.5 µm), bearing 2-4 subpolar appendages at each end; appendages cellular, tubular, unbranched, attenuated, flexuous, 9-20 ($\bar{x}$ = 15) µm; mean conidium length/width ratio = 5.5/1.

Specimens and cultures examined: SFC 1907 (BCC 18523), SFC 1909 (BCC 18582), SFC 1910 (BCC 18524), SFC 1925 (BCC 18604), SFC 1926 (BCC 18605), SFC 1937 (BCC 20807), SFC 1944 (BCC 20811), SFC 2018 (BCC 21259), SFC 2027 (BCC 22446), SFC 2037 (BCC 22450), SFC 2043 (BCC 22452), SFC 2054 (BCC 22456), SFC 2100 (BCC 22954), SFC 2150 (BCC 22472), (Appendix Table 1. for details).

Pycnidial morphology and cylindrical conidia with cellular appendages at both ends are distinguished characters of the genus *Chaetospermum*.

A key to *Chaetospermum* species from the present study

1 Conidial appendages polar ..... *C. artocarpi*
1 Conidial appendages subpolar ..... *C. camellae*

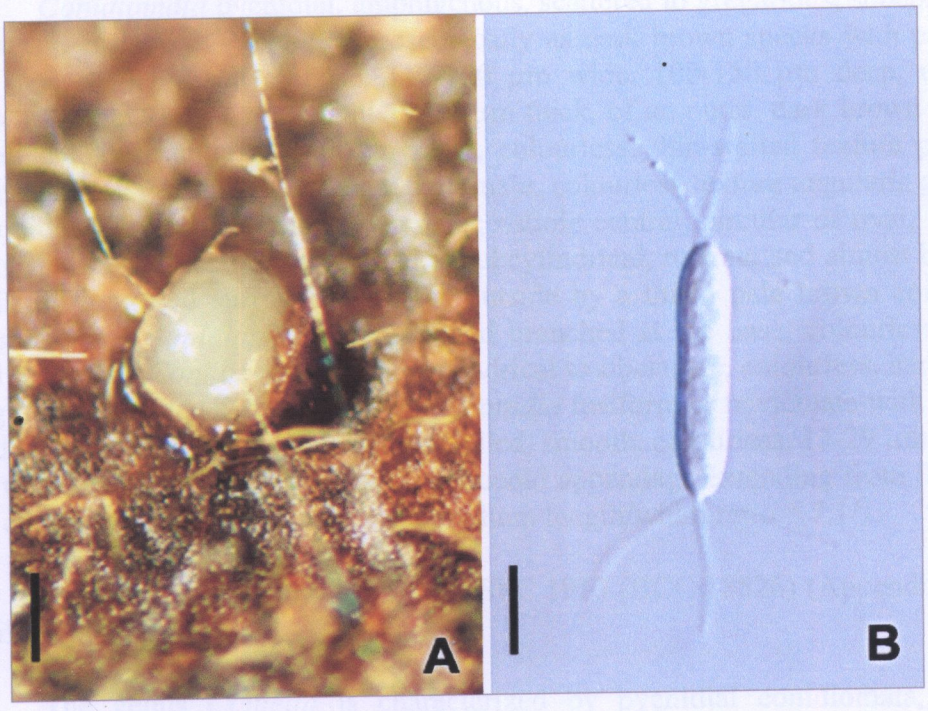

Figure 8. *Chaetospermum artocarpi*: **A,** a conidioma on a natural substratum (bar = 250 µm); **B**, a conidium with polar appendages (bar = 10 µm).

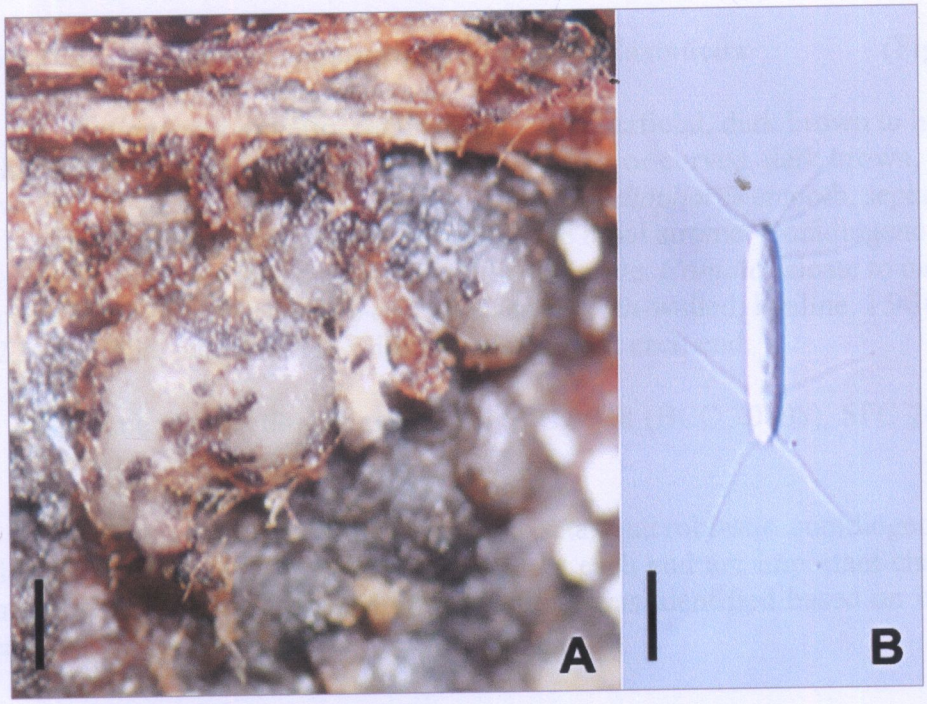

Figure 9. *Chaetospermum camelliae*: **A**, conidiomata on a natural substratum (bar = 250 µm); **B**, a conidium with sub-polar appendages (bar = 10 µm).

5.5 *Coniella castaneicola* (Ellis & Everh.) B. Sutton (Figure 10)

Conidiomata pycnidial, amphigenous, scattered to gregarious, subepidermal in origin, innate-erumpent, visible, macroscopically as dark brown specks with pale brown areolas, oval to depressed globose, 110-120 µm wide, 100-150 µm deep, unilocular, glabrous, ostiolate, dark brown; wall 15-20 µm thick, of an outer, dark brown to brown, thick-walled textura angularis and an inner, colourless, thin-walled textura prismatica, except at the base which has a convex, pulvinate, colourless textura angularis giving rise to the conidiophores or conidiogenous cells; ostiole central, circular or oval, 10-15 µm diam., located in a conical or cylindrical to subcylindrical, rostrate and almost black neck up to 50 µm long and surrounded on the outside by a thick, pale brown epistroma of textura globulosa. *Conidiophores* septate and branched at the base, colourless, smooth, invested in mucus. *Conidiogenous cells* cylindrical to obclavate, colourless, smooth, 8-14 µm long, 2-3 µm wide ($\bar{x}$ = 11 × 2.5 µm). *Conidia* fusiform or naviculate with a truncate base and an obtuse apex, unicellular, thin-walled, smooth, colourless, 13-29 µm long, 2.5-3.5 µm wide ($\bar{x}$ = 20.6 × 2.9 µm), with a mucoid appendage extending from the apex to base on one side of the conidium; mean conidium length/width ratio = 7.1/1.

Specimen and culture examined: SFC 1913 (BCC 18526) (Appendix Table 1. for details).

The genus *Coniella* is characterized by pycnidial conidiomata, branched conidiophores bearing enteroblastic conidiogenous cells, and unicellular, pigmented conidia. *Coniella castaneicola* possesses naviculate conidia with mucoid appendage on one side (Nag Raj, 1993).

5.6 *Dinemasporium lanatum* Nag Raj & R.F. Castañeda (Figure 11)

Conidiomata stromatic, cupulate, setose, superficial, dark brown to black, 300-350 µm high, 300-400 µm wide. Setae subulate, straight or curved, dark brown, thick and smooth-walled, up to 1000 µm long, 4-7 µm wide. *Conidiophores* smooth, septate, hyaline, branched, arising from the upper cells of the basal stroma. Conidiogenous cells integrated, terminal, enteroblastic, cylindrical to obclavate. *Conidia* falcate to naviculate with truncate base and acute apex, 1-cell, thin and smooth-walled, hyaline, 15-30 µm long, 2-2.5 µm wide, with a single filiform appendage at each end.

Specimens and cultures examined: SFC 1938 (BCC 20808), SFC 2019 (BCC 21260), (Appendix Table 1. for details).

Cupulate conidioma with pigmented seta, enteroblastic conidiogenous cells, and naviculate conidia with a cellular appendage at each end are important characters of the genus *Dinemasporium*. *Dinemasporium lanatum* was identified based on its conidial measurements (Nag Raj, 1993).

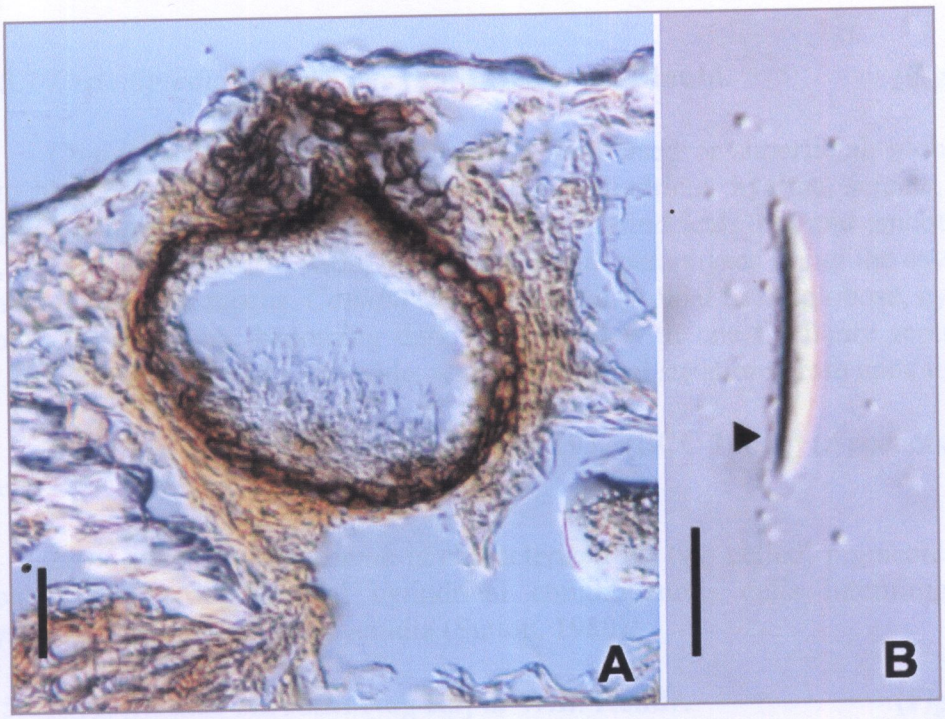

Figure 10. *Coniella castaneicola*: **A**, vertical section of a conidioma in a natural substratum (bar = 50 µm); **B**, a conidium with a mucoid appendage on one side extending from the apex to the base (arrowed) (bar = 10 µm).

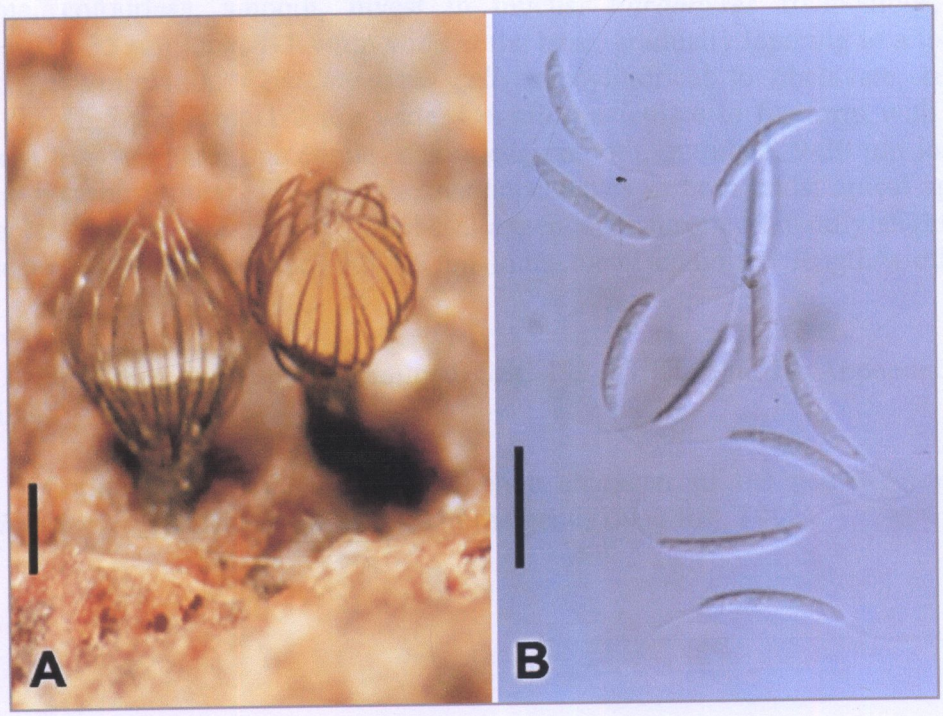

Figure 11. *Dinemasporium lanatum*: **A**., cupulate conidiomata with setae on a natural substratum (bar = 150 µm); **B**, conidia with polar appendages (bar = 20 µm).

5.7 *Lasiodiplodia theobromae* (Pat.) Griffon & Maubl. **(Figure 12)**

Conidiomata scattered or aggregated, immersed or superficial, globose, dark brown to black, 2000-4000 µm diam. *Paraphyses* cylindrical, hyaline, septate, up to 50 µm long. *Conidiogenous cells* holoblastic, discrete, cylindrical, thin and smooth-walled, hyaline, 4-7 µm long, 3-4 µm wide, intermingled with paraphyses lining the cavity of the conidioma, invested in mucus. *Conidia* acrogenous, ellipsoidal to subglobose, hyaline and non septate when young, becoming dark brown and with one medianly septum when mature, 20-30 µm long, 10-15 µm wide, with longitudinal striations from apex to base.

Specimen and culture examined: SFC 1932 (BCC 18611) (Appendix Table 1. for details).

Lasiodiplodia theobromae is characterized by two-celled, pigmented conidia with longitudinal striations and cylindrical conidiogenous cells intermingled with paraphyses lining inside of dark pycnidia (Sutton, 1980).

5.8 *Mycotribulus mirabilis* Nag Raj & W.B. Kendr. **(Figure 13)**

Conidiomata pycnidial, subepidermal, 200-230 µm wide, 110-275 µm deep, unilocular with locule often irregularly divided, glabrous, brown, wall of textura angularis. *Conidiophores* intermingled with paraphyses lining the cavity of the conidioma, colourless, smooth, invest in mucus. *Paraphyses* filamentous, septate, colourless, 15-55 µm long, 1-1.5 µm wide at the base, gradually tapering to a lobed apex of a 1.5-3.5 µm width. *Conidiogenous cells* subcylindrical to obclavate, colourless, smooth, 7.5-16.5 µm long, 1-2 µm wide. *Conidia* naviculate to fusiform with an acute apex and a truncate base, unicellular, colourless, smooth, guttulate, 9-20 µm long, 2-4.5 µm wide, bearing tubular, filiform, flexous appendages at both ends; apical appendage single, polar, straight, 7.5-11 µm long; basal appendages inserted laterally slightly above the truncate base, often curved, 7.5-12 µm long; mean conidium length/width ratio = 4.5/1.

Specimen and culture examined: SFC 1922 (BCC 18601) (Appendix Table 1. for details).

Conidial morphology is a distinctive character of the genus *Mycotribulus*. *Mycotribulus mirabilis* is a single species of the genus (Nag Raj, 1993).

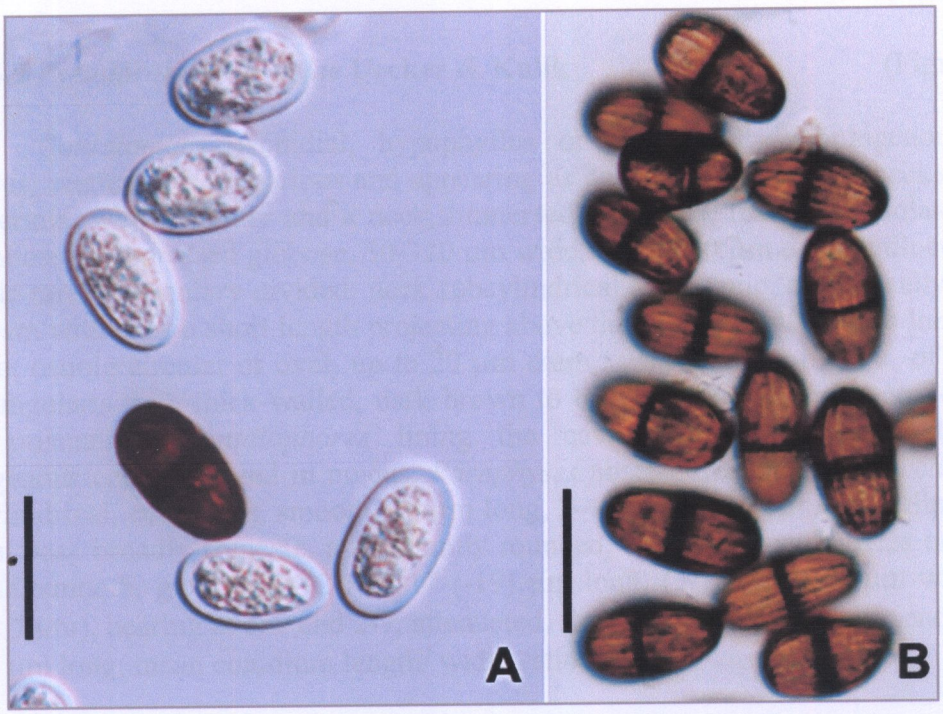

Figure 12. *Lasiodiplodia theobromae*: young (**A**) and mature (**B**) conidia (bar = 30 µm).

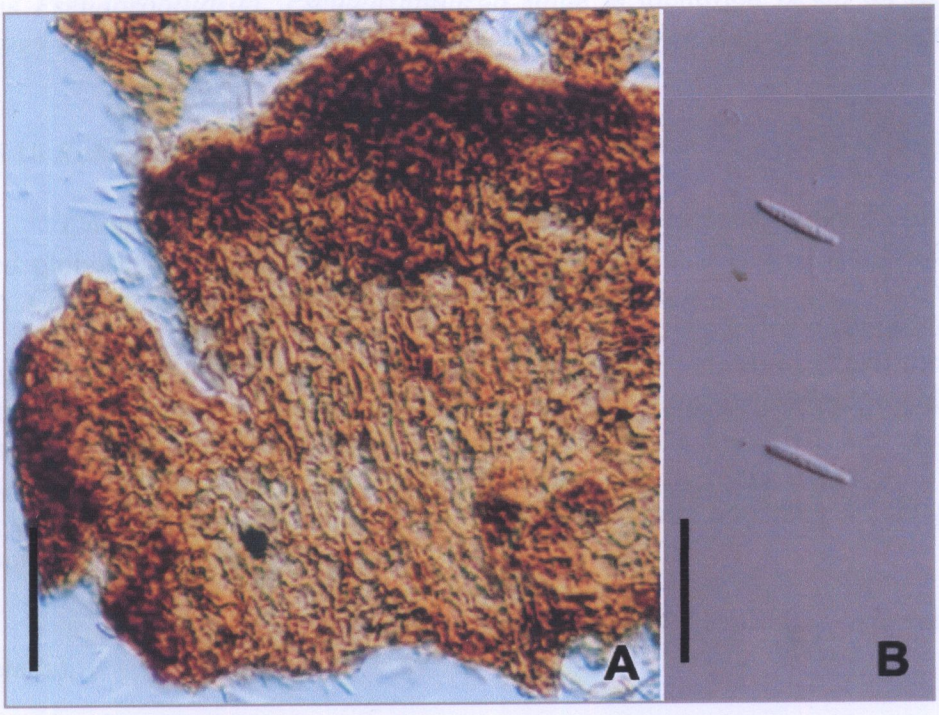

Figure 13. *Mycotribulus mirabilis*: **A**, squash mount of a conidioma showing a pycnidial wall (bar = 50 µm); **B**, conidia (bar = 20 µm).

5.9 *Pseudorobillarda sojae* Uecker & Kulik **(Figure 14)**

Conidiomata pycnidial, hypophyllus or occasionally amphigenous when foliicolous, scattered to gregarious and appearing as dark brown to black specks beneath the epidermis, with a wenter and a neck, immersed, grabrous, fuscous, ostiolate; venter oval, globose or depressed globose, 50-320 µm wide, up to 170 µm deep, unilocular with the locule rarely irregulary divided; neck subcylindrical to obconic, occasionally sinuate, dark brown with only a short length projecting above the substrate, 40-70 µm long, 30-40 µm wide; ostiole circular or oval, up to 20 µm diam.; wall 10-15 µm thick, of an outer textura angularis with thick-walled, dark brown to brown cells and an inner, colourless textura prismatica. *Conidiophores* lining the cavity of the venter, reduced to conidiogenous cells, invested in mucus. *Paraphyses* absent. *Conidiogenous cells* cuboid to subcylindrical, colourless, smooth, 4-7µm long, 3-4.5 µm wide. *Conidia* ellipsoidal to fusiform, base broadly truncate, apex bluntly rounded, unicellular, colourless or slightly yellowish, smooth, guttulate, (12-) 14-17 (-19) µm long, (3-) 3.5-4 (-5) µm wide ($\bar{x}$ = 15.5 × 3.7 µm), bearing at one end 2-7, attenuated, flexuous, extracellular appendages 12-18 (-19) µm long; mean conidium length/ width ratio = 4.1/1.

Specimens and cultures examined: SFC 1902 (BCC 18580), SFC 1934 (BCC 18613), SFC 1939 (BCC 20809) (Appendix Table 1. for details).

A conidium with appendages born inside a sheath is a distinctive character of the genus *Pseudorobillarda*. *Pseudorobillarda sojae* is identified based on its conidial morphology and measurements (Uecker and Kulik, 1986; Nag Raj, 1993; Plaingam *et al.*, 2005).

5.10 *Robillarda sessilis* Sacc. (Sacc.) **(Figure 15)**

Conidiomata pycnidioid, scattered to gregarious, ovoid, globose to depressed globose, glabrous, dark brown to black, ostiolate, 110-210 µm wide, 90-180 µm deep. *Conidiophores* reduced to conidiogenous cells lining the cavity of conidioma, invested in mucus. *Conidiogenous cells* ampulliform to subcylindrical, colourless, thin-walled, smooth, 4-5-7.0 µm long, 2.5-4.0 µm wide. *Conidia* holoblastic, fusiform, straight or slightly curved, smooth, constricted at the median septum, colourless to pale brown, with 1-septate conidium body and a separate apical cell modified into a branched appendage, 8.5-14 µm long, 2.5-3.0 µm wide, apical cell cylindrical for 1-2.5 µm then dividing into 3 divergent branches, devoid of cell contents; appendage 9-23 µm long; mean conidium length/ width ratio = 4/1.

Specimen and culture examined: SFC 1923 (BCC 18602) (Appendix Table 1. for details).

The genus *Robillarda* is characterized by 2-cells of conidium body and a separated apical cell modified into a branched appendage. *Robillarda* species are distinguished by their conidial morphologies and measurements. *Robillarda sessilis* possesses smooth-walled and pigmented conidia with spathulate appendages (Nag Raj, 1993).

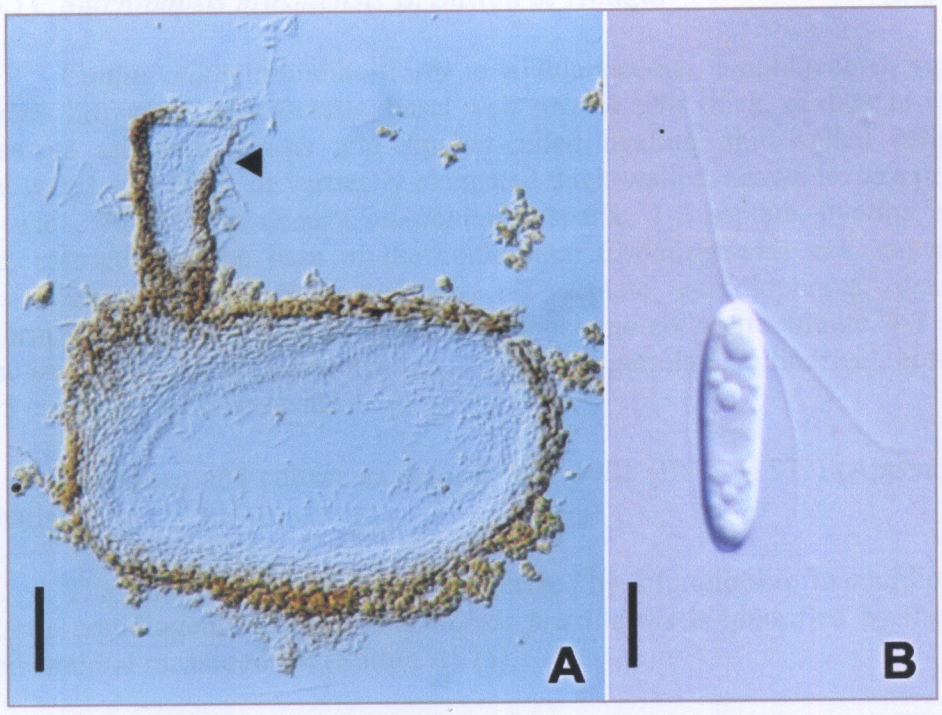

Figure 14. *Pseudorobillarda sojae*: **A**, vertical section of a conidioma with a long, funnel-shaped ostiole (arrowed) (bar = 25 µm); **B**, a conidium with apical appendages (bar = 5 µm).

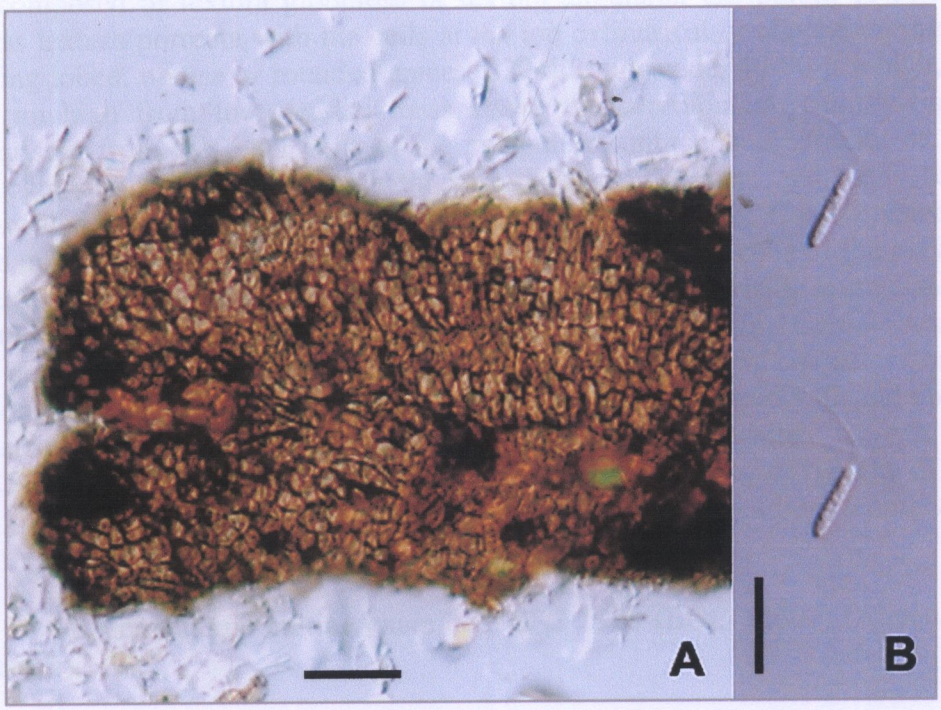

Figure 15. *Robillarda sessilis*: **A**, pycnidial wall (bar = 30 µm); **B**, conidia with an apical, 3-branched appendage (bar = 10 µm).

5.11 *Satchmopsis brasiliensis* B. Sutton & Hodges (Figure 16)

Conidiomata infundibuliform to nidulariaceous, amphigenous, superficial, septate, dark brown to black, sessile; basal wall several cells thick, of dark brown large-celled textura angularis below and smaller-celled hyaline, thin-walled cells above, periclinal wall 1-cell thick, or vertically elongated thick-walled, brown textura prismatica, 175 µm wide, 70-135 µm deep. *Conidiophores* sparse, 1-2 septate, hyaline, sparingly branched, restricted to the base of the conidioma. *Conidiogenous cells* enteroblastic, phialidic, discrete, rarely integrated on 1-2 septate conidiophores, determinate, ampulliform to lageniform, hyaline, smooth, channel and collarette minute, 4-7 µm long, 2.5-3 µm wide. *Conidia* nidulant, hyaline, aseptate, ± guttulate, cylindrical, obtuse ends, 11.5-15.5 µm long, 1-1.5 µm wide.

Specimen and culture examined: SFC 1901 (BCC 18579) (Appendix Table 1. for details).

The genus *Satchmopsis* is characterized by infundibuliform conidiomata and enteroblastic conidiogenous cells. *Satchmopsis brasiliensis* is identified by the conidial shape and conidial measurement (Sutton, 1975).

5.12 *Xepicular leucotricha* (Peck) Nag Raj (Figure 17)

Conidiomata stromatic, pulvinate to cupulate with an excipulum, a white, setose fringe, and agglutinated greenish conidial mass above the conidiomata; basal stroma composed of textura globulosa or textura angularis; excipulum of compact and colourless textura porrecta with the cells at the top cylindrical or clavate, terminally free and having lobed, obtuse or rounded apices, 220-400 µm wide, 40-90 µm high, often up to 180 µm high from the conidial mass above the conidiomata. *Conidiomatal setae* sparse, arising from the outer cells of the excipulum, unbranched, straight or variously curved, cylindrical to subulate, with thick walls, narrow lumen, and many thin septa, smooth-walled, colourless, up to 200 µm long, 8-11 µm wide. *Conidiophores* arising from the uppermost cells of the basal stroma and inner layer of cells of the excipulum in the concavity of the conidiomata, unbranched or with branches arising immediately below the septa, well compacted in a hymenium, colourless, smooth. *Conidiogenous cells* discrete or integrated, subcylindrical to lageniform or ampulliform, colourless, smooth, 9-15 µm long, 2-3 µm wide. *Conidia* holoblastic, fusiform to ellipsoid with and obtuse apex and a narrow, truncate base, unicellular, pale olivaceous, thin-walled, smooth, 6-11 µm long, 1.5-2.5 µm wide, with an mucoid appendage, arising by reversion of a partial mucoid sheath at the apex of the developing conidium, mean conidium length/wide ratio = 4/1.

Specimen and culture examined: SFC 1928 (BCC 18607) (Appendix Table 1. for details).

The genus *Xepicular* is characterized by cupulate conidiomata with hyaline and septate setae, and without excipular element. *Xepicular leucotricha* is identified based on the conidial measurement and morphology of the seta (Nag Raj, 1993).

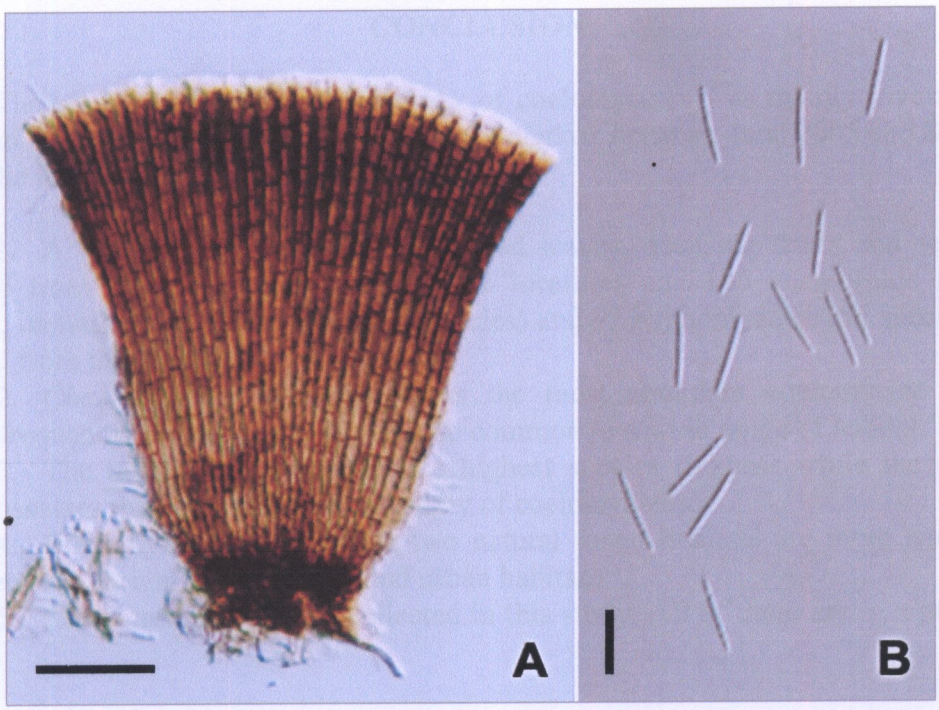

Figure 16. *Satchmopsis brasiliensis*: **A**, a funnel-shaped conidioma (bar = 50 µm); **B**, cylindrical conidia (bar = 10 µm).

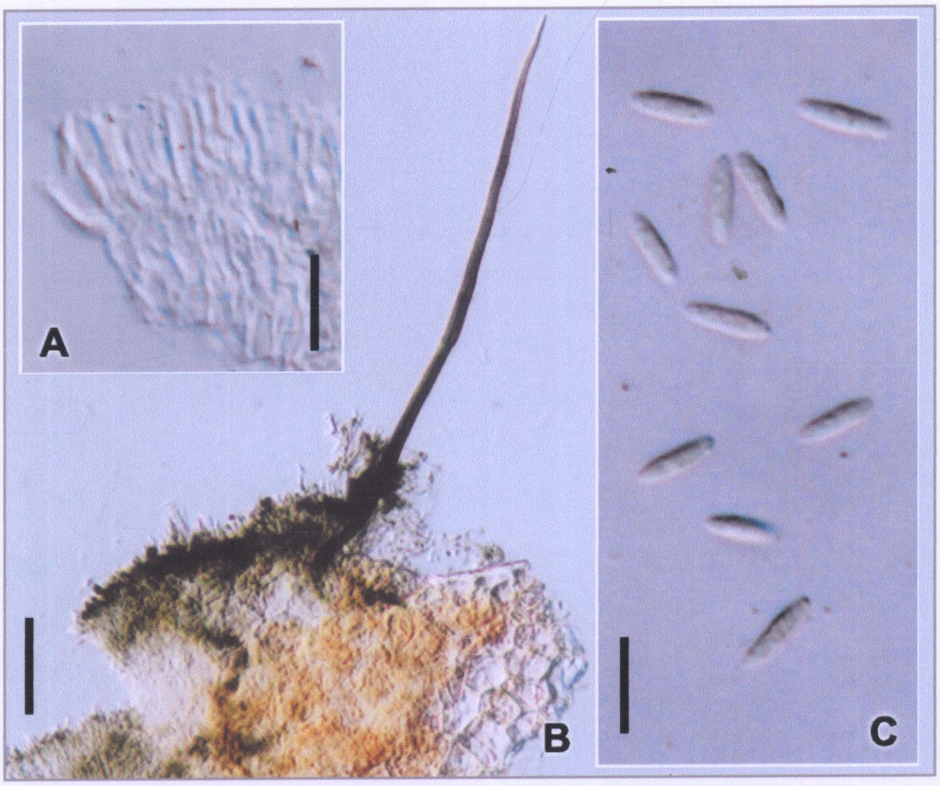

Figure 17. *Xepicular leucotricha*: **A**, conidiogenous cells (bar = 10 µm); **B**, conidioma with a pigmented seta (bar = 100 µm); **C**, conidia (bar = 10 µm).

CONCLUSION

The study on diversity and ecology of coelomycetes was mainly investigated in Khao Yai National Park and in urban park of Bangkok between June 2005 and September 2006. The followings are the result summary:

1. A total 643 samples of twigs, dead leaves, decaying fruits and seeds were collected from six different habitats in five localities and 146 anamorphic fungi (78 species), including 54 coelomycetes (22 species) and 92 hyphomycetes (56 species), were recorded from these samples.
2. *Chaetospermum camelliae* was the most abundant coelomycete with the highest frequency of occurrence. It was also common to a wide range of habitat.
3. The urban park possesses the highest species richness while the evergreen forest possesses the highest species diversity of coelomycetes.
4. Coelomycetes between the two natural forest habitats are more similar than those between natural forest habitat and urban habitat.
5. Seven new fungi were collected in this study. All of them are in a publication process.

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APPENDIX 1: APPENDIX TABLES

Appendix Table 1. Coelomycetes collected in the present study

No.	SFC	BCC*	Fungi**	Substrata***	Habitat	Localities****	Collected	Isolated
1	1901	18579	*Satchmopsis brasiliensis*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	06/07/2005
2	1902	18580	*Pseudorobillarda sojae*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	06/07/2005
3	1904	18581	*Chaetospermum artocarpi*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	06/07/2005
4	1905	18522	*Diplodia* sp.	T: *Eupatorium odoratum*	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	06/07/2005
5	1907	18523	*Chaetospermum camelliae*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	06/07/2005
6	1909	18582	*Chaetospermum camelliae*	L: *Typha angustifolia*	Swamp forest	Pathum Thani	01/06/2005	06/07/2005
7	1910	18524	*Chaetospermum camelliae*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	07/07/2005
8	1912	18583	Unidentified sp. 1	L: *Lagerstroemia floribunda*	Grassland	Khao Yai Nat. Park- 2	15/06/2005	12/07/2005
9	1913	18526	*Coniella castaneicola*	L: *Eucalyptus* sp.	Urban forest	Chatuchak, Bangkok	09/07/2005	15/07/2005
10	1915	18527	*Pestalotiopsis* sp.	L: *Eucalyptus* sp.	Urban forest	Chatuchak, Bangkok	09/07/2005	15/07/2005
11	1917	18599	*Bartalinia robillardoides*	L: *Lagerstroemia loudonii*	Urban forest	Chatuchak, Bangkok	09/07/2005	25/07/2005
12	1918	18584	*Phoma* sp.	L: *Eucalyptus* sp.	Urban forest	Chatuchak, Bangkok	09/07/2005	25/07/2005
13	1918	18585	*Phoma* sp.	L: *Eucalyptus* sp.	Urban forest	Chatuchak, Bangkok	09/07/2005	25/07/2005
14	1919	18528	*Chaetomella raphigera*	L: *Eucalyptus* sp.	Urban forest	Chatuchak, Bangkok	09/07/2005	25/07/2005
15	1920	18586	Unidentified sp. 2	L: *Eucalyptus* sp.	Urban forest	Chatuchak, Bangkok	09/07/2005	25/07/2005
16	1921	18600	*Bartalinia robillardoides*	L: *Lagerstroemia loudonii*	Urban forest	Chatuchak, Bangkok	09/07/2005	17/08/2005
17	1922	18601	*Mycotribulus mirabilis*	L: *Lagerstroemia loudonii*	Urban forest	Chatuchak, Bangkok	09/07/2005	17/08/2005
18	1923	18602	*Robillarda sessilis*	L: *Lagerstroemia loudonii*	Urban forest	Chatuchak, Bangkok	09/07/2005	17/08/2005
19	1924	18603	*Pestalotiopsis* sp.	L: *Lagerstroemia loudonii*	Urban forest	Chatuchak, Bangkok	09/07/2005	17/08/2005
20	1925	18604	*Chaetospermum camelliae*	L: *Lagerstroemia loudonii*	Urban forest	Chatuchak, Bangkok	09/07/2005	17/08/2005
21	1926	18605	*Chaetospermum camelliae*	L: *Lagerstroemia speciosa*	Urban forest	Chatuchak, Bangkok	09/07/2005	17/08/2005
22	1928	18607	*Xepicular leucotricha*	L: *Lagerstroemia speciosa*	Urban forest	Chatuchak, Bangkok	09/07/2005	17/08/2005
23	1931	18610	*Pestalotiopsis* sp.	L: *Lagerstroemia speciosa*	Urban forest	Chatuchak, Bangkok	09/07/2005	18/08/2005
24	1932	18611	*Lasiodiplodia theobromae*	L: *Lagerstroemia speciosa*	Urban forest	Chatuchak, Bangkok	09/07/2005	18/08/2005
25	1933	18612	*Coniella castaneicola*	L: *Lagerstroemia speciosa*	Urban forest	Chatuchak, Bangkok	09/07/2005	18/08/2005
26	1934	18613	*Pseudorobillarda sojae*	L: *Lagerstroemia speciosa*	Urban forest	Chatuchak, Bangkok	09/07/2005	18/08/2005
27	1936	18614	*Satchmopsis brasiliensis*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	28/08/2005
28	1937	20807	*Chaetospermum camelliae*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	10/06/2005
29	1938	20808	*Dinemasporium lanatum*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	10/07/2005
30	1939	20809	*Pseudorobillarda sojae*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	19/10/2005

Appendix Table 1. (Continued).

No.	SFC	BCC*	Fungi**	Substrata***	Habitat	Localities****	Collected	Isolated
31	1940	+	**Unidentified sp. 3**	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	19/10/2005
32	1941	20494	Unidentified sp. 4	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	13/09/2005	20/10/2005
33	1942	20810	*Satchmopsis brasiliensis*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	13/09/2005	27/10/2005
34	1943	+	**Unidentified sp. 3**	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	13/09/2005	27/10/2005
35	1944	20811	*Chaetospermum camelliae*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	27/09/2005	11/12/2005
36	1946	20812	Unidentified sp. 5	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	13/09/2005	14/12/2005
37	1947	20495	*Pseudorobillarda sojae*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	13/09/2005	14/12/2005
38	1951	20813	*Pestalotiopsis* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 4	15/12/2005	26/12/2005
39	1953	20814	*Infundibula* sp.	Leaves: bamboo	Bamboo forest	Nakhon Nayok	15/06/2005	01/07/2005
40	2013	21254	*Phomopsis* sp.	Fruits	Evergreen forest	Khao Yai Nat. Park- 5	01/03/2006	28/03/2006
41	2017	21258	*Pestalotiopsis* sp.	Fruits	Evergreen forest	Khao Yai Nat. Park- 5	01/03/2006	28/03/2006
42	2018	21259	*Chaetospermum camelliae*	Fruits	Evergreen forest	Khao Yai Nat. Park- 5	01/03/2006	28/03/2006
43	2019	21260	*Dinemasporium lanatum*	Fruits	Evergreen forest	Khao Yai Nat. Park- 6	01/03/2006	28/03/2006
44	2025	21262	*Pestalotiopsis* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	06/01/2006	29/03/2006
45	2027	22446	*Chaetospermum camelliae*	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	06/01/2006	29/03/2006
46	2037	22450	*Chaetospermum camelliae*	Fruits (pods)	Evergreen forest	Khao Yai Nat. Park- 6	01/03/2006	03/04/2006
47	2043	22452	*Chaetospermum camelliae*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	01/03/2006	03/04/2006
48	2054	22456	*Chaetospermum camelliae*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	01/03/2006	04/04/2006
49	2065	22049	*Vermiculariopsiella* sp.	Twigs	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	24/04/2006
50	2075	22244	*Vermiculariopsiella* sp.	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	25/04/2006
51	2100	22954	*Chaetospermum camelliae*	Twigs	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	01/05/2006
52	2102	22056	*Phoma* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 5	11/04/2006	04/05/2006
53	2105	22472	*Chaetospermum camelliae*	Leaves	Evergreen forest	Khao Yai Nat. Park- 5	10/04/2006	04/05/2006
54	2109	21373	Unidentified sp. 6	Leaves	Evergreen forest	Khao Yai Nat. Park- 5	10/04/2006	04/05/2006

Remark: * + = culture is in preparation for BCC deposition

** A fungus in bold face is considered as a new species

*** Substrata: F = fruits, L = dead leaves, T = dead twigs

**** Localities: Khao Yai National Park- 1 = Khao Khaew site, Khao Yai National Park- 2 = Grassland
Khao Yai National Park- 3 = Mor Singto site, Khao Yai National Park- 4 = Tan Rattana Waterfall site
Khao Yai National Park- 5 = Nong Phak She site, Khao Yai National Park- 6 = Wang Jum Pee site

Appendix Table 2. Hyphomycetes collected in the present study

No.	SFC	BCC *	Fungi **	Substrata ***	Habitat	Localities****	Collected	Isolated
1	1646	18575	*Tetraploa* sp.	L: *Typha angustifolia*	Swamp forest	Pathum Thani	01/06/2005	06/07/2005
2	1647	18519	*Myrothecium verrucaria*	L: *Typha angustifolia*	Swamp forest	Pathum Thani	01/06/2005	01/07/2005
3	1648	18520	*Myrothecium verrucaria*	L: *Typha angustifolia*	Swamp forest	Pathum Thani	01/06/2005	01/07/2005
4	1649	18576	***Lauriomyces* sp. 1**	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	06/07/2005
5	1649	18577	***Lauriomyces* sp. 1**	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	06/07/2005
6	1650	18578	*Menisporopsis pirozynskii*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	06/07/2005
7	1654	20789	*Kionochaeta ramifera*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	10/06/2005
8	1655	18596	*Memnoniella echinata*	L: *Lagerstroemia speciosa*	Urban forest	Chatuchak, Bangkok	09/07/2005	18/08/2005
9	1656	+	Unidentified sp. 7	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	10/06/2005
10	1657	+	Unidentified sp. 7	F: *Quercus kerrii*	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	10/06/2005
11	1658	18597	*Dictyosporium digitatum*	T: *Quercus* sp.	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	23/08/2005
12	1659	18598	*Lauriomyces* sp.	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	23/08/2005
13	1660	+	**Unidentified sp. 8**	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	10/06/2005
14	1661	20790	*Menisporopsis theobromae*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	10/06/2005
15	1664	20791	*Menisporopsis theobromae*	F: *Quercus kerrii*	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	10/07/2005
16	1665	20792	*Gonytrichum* sp.	F: *Quercus kerrii*	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	10/07/2005
17	1666	20793	*Haplographium* sp.	F: *Quercus kerrii*	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	10/07/2005
18	1668	20794	*Menisporopsis theobromae*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	19/10/2005
19	1669	20795	*Inesiomyces longispirale*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	19/10/2005
20	1670	20796	*Haplographium* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	19/10/2005
21	1672	20491	*Volutella* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	20/10/2005
22	1673	20797	*Haplographium* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	14/09/2005	24/10/2005
23	1674	20494	*Myrothecium* sp. 1	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	13/09/2005	27/10/2005
24	1676	-	***Falcocladium* sp. 1**	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	13/09/2005	27/10/2005
25	1678	20798	*Chalara* sp.	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	27/09/2005	11/04/2005
26	1679	20799	*Cancelladium* sp.	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	27/09/2005	11/04/2005
27	1680	20493	*Cryptophiale aristata*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	27/09/2005	11/04/2005
28	1681	20800	*Menisporopsis theobromae*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	27/09/2005	11/04/2005
29	1682	-	***Calcarisporium* sp. 1**	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	13/09/2005	14/12/2005
30	1687	20802	*Volutella* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 4	11/12/2005	26/12/2005

Appendix Table 2. (Continued).

No.	SFC	BCC *	Fungi **	Substrata ***	Habitat	Localities ****	Collected	Isolated
31	1688	20803	*Wiesneriomyces conjunctosporus*	Leaves	Evergreen forest	Khao Yai Nat. Park- 4	11/12/2005	26/12/2005
32	1689	+	***Wiesneriomyces* sp. 2**	Leaves	Evergreen forest	Khao Yai Nat. Park- 4	11/12/2005	26/12/2005
33	1690	20804	*Cryptophiale kakombensis*	Leaves	Evergreen forest	Khao Yai Nat. Park- 4	11/12/2005	21/12/2005
34	1691	20805	*Cryptophiale udagawae*	Leaves	Evergreen forest	Khao Yai Nat. Park- 4	11/12/2005	26/12/2005
35	1692	20806	*Gyrothrix* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 4	11/12/2005	26/12/2005
36	1911	18525	*Wiesneriomyces conjunctosporus*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	15/06/2005	07/07/2005
37	1927	18606	*Wiesneriomyces conjunctosporus*	L: *Lagerstroemia speciosa*	Urban forest	Chatuchak, Bangkok	09/07/2005	17/08/2005
38	1929	18608	***Wiesneriomyces* sp. 1**	L: *Lagerstroemia speciosa*	Urban forest	Chatuchak, Bangkok	09/07/2005	18/08/2005
39	1930	18609	*Wiesneriomyces laurinus*	L: *Lagerstroemia speciosa*	Urban forest	Chatuchak, Bangkok	09/07/2005	18/08/2005
40	2001	21246	*Stilbella* sp.	Twigs	Evergreen forest	Khao Yai Nat. Park- 4	15/12/2005	20/03/2006
41	2002	21247	*Graphium microsperma*	Leaves	Evergreen forest	Khao Yai Nat. Park- 4	15/12/2005	20/03/2006
42	2003	21248	*Volutella* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 4	15/12/2005	20/03/2006
43	2004	21249	*Stilbella* sp.	Fruits	Evergreen forest	Khao Yai Nat. Park- 4	01/03/2006	20/03/2006
44	2006	21250	*Thozetella* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	01/03/2006	22/03/2006
45	2007	21251	*Volutella* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	01/03/2006	22/03/2006
46	2008	21252	*Cylindrocladium* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	01/03/2006	24/03/2006
47	2011	21253	*Thozetella* sp.	Seeds	Evergreen forest	Khao Yai Nat. Park- 5	01/03/2006	28/03/2006
48	2014	21255	*Dactylaria* sp.	Fruits	Evergreen forest	Khao Yai Nat. Park- 5	01/03/2006	28/03/2006
49	2015	21256	Unidentified sp. 9	Fruits	Evergreen forest	Khao Yai Nat. Park- 5	01/03/2006	28/03/2006
50	2021	22444	*Tretopileus sphaerophorus*	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	06/01/2006	23/03/2006
51	2023	22445	*Thozetella* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	06/01/2006	29/03/2006
52	2024	21261	*Cladosporium chlorocephalum*	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	06/01/2006	29/03/2006
53	2026	21263	*Trichoderma* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	06/01/2006	29/03/2006
54	2029	22447	*Stachybotrys* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	06/01/2006	29/03/2006
55	2030	22448	*Penicillium* sp. 1	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	06/01/2006	29/03/2006
56	2031	21264	*Penicillium* sp. 2	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	06/01/2006	29/03/2006
57	2032	22449	*Volutella* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	01/03/2006	03/04/2006
58	2035	21265	*Clonostachy solani*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	01/03/2006	03/04/2006
59	2036	22515	*Volutella* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 6	01/03/2006	03/04/2006
60	2039	21266	*Clonostachy solani*	Fruits (pods)	Evergreen forest	Khao Yai Nat. Park- 6	01/03/2006	03/04/2006

Appendix Table 2. (Continued).

No.	SFC	BCC *	Fungi **	Substrata ***	Habitat	Localities ****	Collected	Isolated
61	2040	22451	*Thozetella* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	01/03/2006	03/04/2006
62	2042	21267	*Volutella* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	01/03/2006	03/04/2006
63	2044	21268	*Penicillium* sp. 3	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	01/03/2006	03/04/2006
64	2047	22453	Unidentified sp. 10	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	01/03/2006	03/04/2006
65	2058	22458	*Volutella* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	01/03/2006	04/04/2006
66	2061	22459	*Humicola grisea*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	24/04/2006
67	2062	22460	*Cladosporium chlorocephalum*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	01/03/2006	03/04/2006
68	2063	22461	Unidentified sp. 9	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	25/04/2006
69	2066	22462	*Myrothecium* sp. 2	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	24/04/2006
70	2067	22463	*Chloridium* sp.	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	25/04/2006
71	2069	22050	Unidentified sp. 11	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	25/04/2006
72	2074	22464	*Kionochaeta ramifera*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	25/04/2006
73	2078	22466	*Cryptophiale udagawae*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	25/04/2006
74	2079	22467	*Zygosporium* sp.	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	26/04/2006
75	2086	22051	*Chaetopsina fulva*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	24/04/2006
76	2088	22053	**Unidentified sp. 12**	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	26/04/2006
77	2093	22516	*Chaetopsina fulva*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	01/05/2006
78	2094	22517	*Gyrothrix microsperma*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	01/05/2006
79	2095	22468	Unidentified sp. 13	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	01/05/2006
80	2096	22469	*Thozetella* sp.	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	01/05/2006
81	2097	22470	Unidentified sp. 14	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	01/05/2006
82	2098	22518	Unidentified sp. 15	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	01/05/2006
83	2099	22471	*Menisporopsis theobromae*	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	01/05/2006
84	2101	22055	***Falcocladium* sp. 1**	Leaves	Hill evergreen forest	Khao Yai Nat. Park- 1	11/04/2006	01/05/2006
85	2106	22473	*Cladosporium chlorocephalum*	Leaves	Evergreen forest	Khao Yai Nat. Park- 5	10/04/2006	04/05/2006
86	2107	22474	*Volutella* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 5	10/04/2006	04/05/2006
87	2108	22475	*Clonostachy solani*	Leaves	Evergreen forest	Khao Yai Nat. Park- 5	10/04/2006	04/05/2006
88	2110	21374	*Stachybotrys* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	11/04/2006	04/05/2006
89	2112	22057	Unidentified sp. 16	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	11/04/2006	04/05/2006
90	2117	21375	*Dictyochaeta* sp.	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	11/04/2006	04/05/2006

Appendix Table 2. (Continued).

No.	SFC	BCC *	Fungi **	Substrata ***	Habitat	Localities ****	Collected	Isolated
91	2118	21376	*Phialocephala bactrospora*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	11/04/2006	04/05/2006
92	2121	21377	*Lauriomyces sakaeratensis*	Leaves	Evergreen forest	Khao Yai Nat. Park- 3	11/04/2006	04/05/2006

Remark: * + = culture is in preparation for BCC deposition

** A fungus in bold face is considered as a new species

*** Substrata: F = fruits, L = dead leaves, T = dead twigs

**** Localities: Khao Yai National Park- 1 = Khao Khaew site, Khao Yai National Park- 2 = Grassland
Khao Yai National Park- 3 = Mor Singto site, Khao Yai National Park- 4 = Tan Rattana Waterfall site
Khao Yai National Park- 5 = Nong Phak She site, Khao Yai National Park- 6 = Wang Jum Pee site

APPENDIX 2: OUTPUTS

สรุป OUTPUTS ที่ได้รับจากการดำเนินงาน

ชื่อโครงการวิจัย เชื้อรากลุ่ม Coelomycetes ในประเทศไทย: ความหลากหลายและนิเวศวิทยาในอุทยานแห่งชาติเขาใหญ่ (รหัสโครงการ BRT R_149001) ตั้งแต่เดือน ตุลาคม พ.ศ. 2548 ถึง กันยายน พ.ศ. 2549

1. การตีพิมพ์บทความในวารสารวิชาการ

1.1 ตีพิมพ์เรียบร้อยแล้ว (published) จำนวน 1 เรื่อง ดังนี้
(ระบุชื่อผู้แต่ง (Authors), ชื่อเรื่อง (Title), ชื่อวารสารพร้อม volume และเลขหน้า)

1. Somrithipol, S. & E. B. G. Jones. 2006. *Calcarisporium phaeopodium* sp. nov., a new hyphomycete from Thailand. Sydowia 58: 133-140.

1.2 อยู่ระหว่างการตีพิมพ์ (in press) จำนวน 1 เรื่อง ดังนี้
(ระบุชื่อผู้แต่ง (Authors), ชื่อเรื่อง (Title), ชื่อวารสาร)

1. Somrithipol, S. & E.B.G. Jones. 2007. *Lauriomyces cylindricus* and *Lauriomyces ellipticus* spp. nov., two new hyphomycetes from tropical forest of Thailand. Nova Hedwigia

1.3 อยู่ระหว่างส่งต้นฉบับให้วารสารวิชาการ (submitted) จำนวน 1 เรื่อง ดังนี้
(ระบุชื่อผู้แต่ง (Authors), ชื่อเรื่อง (Title))

1. Somrithipol, S., N. Sudhom, S. Tippawan, & E.B.G. Jones. 2007. A new species of *Falcocladium* with turbinate vesicle from Thailand. Sydowia

1.4 อยู่ในระหว่างการจัดทำต้นฉบับ (in manuscript) จำนวน 2 เรื่อง ดังนี้
(ระบุชื่อผู้แต่ง (Authors), ชื่อเรื่อง (Title))

1. Somrithipol, S. *Bivalviopsis*: a new genus of anamorphic fungi from Thailand
2. Somrithipol, S. A synnematous species of *Dictyoarthrinium* from Thailand

2. การตีพิมพ์ผลงานในรูปแบบ Proceedings/คู่มือ/หนังสือ หรืออื่นๆ (โปรดระบุ) จำนวน - เรื่อง ดังนี้

ไม่มี

3. การนำเสนอผลงานในรูปแบบโปสเตอร์ จำนวน 1 เรื่อง ดังนี้

1. Somrithipol, S. and E.B.G. Jones. 2006. Three new anamorphic fungi from Khao Yai National Park. In The Annual Meeting of Thai Mycological Association (TMA) and Mycology Conference in Thailand, 28-29 October 2006. King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand. p. 43

4. จำนวนนักศึกษาระดับปริญญาตรี โท เอก ในโครงการ จำนวน - คน ดังนี้
(ระบุชื่อนักศึกษา, ชื่อวิทยานิพนธ์, ระดับการศึกษา)

ไม่มี

ลงนาม.....

(นายสายัณห์ สมฤทธิ์ผล)
ผู้รับทุน
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APPENDIX 3: BUDGET REPORT