

# A monograph of the genera *Crinipellis* and *Moniliophthora* from Southeast Asia including a molecular phylogeny of the nrITS region

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Nineteen species of *Crinipellis* (Basidiomycota, Agaricales) and three species of *Moniliophthora* (Basidiomycota, Agaricales) are described from Southeast Asia. Thirteen relevant type studies along with excluded and insufficiently known taxa are also included. Five new species and one new form of *Crinipellis* (*C. brunnescens*, *C. cupreostipes*, *C. dipterocarpi* f. *cinnamomea*, *C. furcata*, *C. malesiana* and *C. tabtim*), one new species of *Moniliophthora* (*M. marginata*) and three formal transfers of species described originally as *Crinipellis* (*Moniliophthora canescens*, *Moniliophthora nigrilineata* and *Marasmiellus subochraceus*) are proposed here. These are the first distribution reports of *Crinipellis* and *Moniliophthora* for Thailand, Malaysia and Indonesia and the geographic distributions were expanded for *C. actinophora*, *C. brunneipurpurea*, *C. dipterocarpi*, *C. aff. iopus*, *C. aff. mirabilis*, *C. setipes* and *C. trichialis*. Phylogenetic analyses of 12 Southeast Asian *Crinipellis*, three *Moniliophthora* and six *Chaetocalathus* species are included using sequence data from the nrDNA ITS region. Comprehensive descriptions for all 36 taxa along with illustrations when available are included in this study.

**Keywords:** Marasmiaceae, Agaricomycotina, molecular phylogeny, fungal taxonomy.

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## Introduction

The biodiversity in Southeast Asia is among the world's richest. The region is home to 16 endemic vascular plant families (Takhtajan *et al.*, 1986) and contains three of the top ten biodiversity hotspots as described by Meyers (2000). Although the fungi remain largely understudied in this region, there have been recent studies of saprotrophic fungi (Desjardin and Horak, 1999; Desjardin *et al.*, 2000; Wilson *et al.*, 2004; Wannathes *et al.*, 2004, 2007; Tan *et al.*, 2007). These fungi play very important ecological roles in litter decomposition and nutrient recycling. The following is a regional monograph of the basidiomycete genera *Crinipellis* Pat. and *Moniliophthora* H.C. Evans, Stalpers, Samson & Benny that includes a phylogenetic analysis of the nrITS region.

The crinipelloid genera *Crinipellis*, *Moniliophthora* and *Chaetocalathus* Singer (Basidiomycota, Agaricales) are distinguished

morphologically from the allied genus *Marasmius* Fr. by basidiomes with pileipellis composed of thick-walled, dextrinoid, hair-like terminal cells. *Chaetocalathus* differs from the other two genera by formation of non-stipitate basidiomes. Taxonomically significant features useful in distinguishing amongst crinipelloid species include pileus coloration, presence or absence of rhizomorphs, substrate type, cheilocystidia shape, presence or absence of pleurocystidia, basidiospore shape and size, and KOH reaction of pileipellis cells.

The genus *Crinipellis* was established by N. Patouillard in 1889 with *Agaricus stipitarius* Fr. as the type species. The first worldwide treatment of the genus was published by Singer (1943) in which he recognized 33 stipitate species of *Crinipellis* placed into two sections, and he created the allied genus *Chaetocalathus* for eleven non-stipitate species. In 1976, Singer reworked the neotropical *Crinipellis*, recognizing 41 species belonging to four sections. In Singer's "The Agaricales in Modern

Taxonomy" (1986), he reported 5 infrageneric groups, viz., sections *Crinipellis*, *Metuloidophorae*, *Excentricinae*, *Grisentinae* and *Iopodinae*.

Currently, over 150 epithets have been published in the genus with 75 species recognized as being distinct (Kirk *et al.*, 2001). Patouillard described a number of *Crinipellis* species (a few of which have since been transferred to the genus *Chaetocalathus*) from Southeast Asia, primarily from Vietnam. As mentioned above, Singer also described new species in, and made new transfers into, the genus from the region. Recently, E.J.H. Corner (1996) reported six species of *Crinipellis*, five of which were described as new species from Singapore and peninsular Malaysia. To date, fourteen species of crinipelloid fungi have been reported from Southeast Asia, viz., 12 species of *Crinipellis*, and two species of the non-stipitate genus *Chaetocalathus*. Another two species of previously reported *Crinipellis* are transferred out of the genus in this study; therefore, leaving 10 previously reported species of *Crinipellis* from Southeast Asia: *C. actinophora* (Berk. & Broome) Singer, *C. atrobrunnea* Pat., *C. brunneipurpurea* Corner, *C. carecomoeis* var. *litseae* Singer, *C. cervinoalba* Corner, *C. dipterocarpi* Singer, *C. hepatica* Corner, *C. pseudostipitaria* subsp. *orientalis* Singer, *C. sepiaria* Pat. & Demange, and *C. trichialis* (Lév.) Pat. ex Antonín *et al.* To date, no monographic treatment or phylogenetic analysis of Southeast Asian *Crinipellis* has been published.

In addition to the reports of *Crinipellis* from Southeast Asia, there are a few reports of *Crinipellis* from the Old World (excluding Europe). In 1968 Singer described one new combination and two new species of *Crinipellis* from Africa (Singer in Pegler, 1968). Stevenson (1964) reported eight species of *Crinipellis* from New Zealand, and Pegler (1977) reported 5 East African species of *Crinipellis*, and another three species of *Crinipellis* from Sri Lanka (Pegler, 1986). In 2000, Takahashi described three new species of *Crinipellis* from Japan. In this monograph, the taxonomic position of a few of the previously

reported species of *Crinipellis* mentioned here has been revised.

*Crinipellis* has a worldwide distribution with the greatest diversity in the tropics. Singer (1943) noted an interesting distribution of *Crinipellis* with the greatest concentration in the Neotropics as compared to the Old World tropics, as seen in many other genera. This observation may be a result of the paucity of saprotrophic fungal collections and research in the Old World tropics.

The genus has been recognized historically as containing both saprotrophic and parasitic species. Recently, the economically and ecologically important cacao pathogen *Crinipellis pernicioso* (Stahel) Singer, also known as the witches' broom disease, was transferred to the genus *Moniliophthora* (as *Moniliophthora pernicioso* (Stahel) Aime and Phillips-Mora, 2005). The majority of species are saprotrophic; however, there are a few reports of parasitic species including *C. siparunae* Singer, *C. pseudostipitaria* and the type of the genus, *C. stipitaria* (Fr.) Pat. (= *C. scabella* (Alb. & Schwein.) Murrill), which has been observed to be parasitic on grasses and cereal plants (Singer, 1943).

*Crinipellis* species have been included in a few molecular studies; however, there has not been a comprehensive molecular study of the genus. These studies indicate potential sister relationships and taxonomic placement of *Crinipellis*. Recent molecular sequence data by Moncalvo *et al.* (2002), Bodensteiner *et al.* (2004), Wilson and Desjardin (2005) and Matheny *et al.* (2006) indicate that *Crinipellis* and *Chaetocalathus* are sister to *Marasmius sensu stricto*. However, an analysis by Aime & Phillips-Mora (2005) resulted in *Crinipellis* as sister to a clade containing *Chaetocalathus*, *Moniliophthora* and *Marasmius sensu stricto*.

The goal of this research was to document the diversity, distribution and ecology of *Crinipellis* and *Moniliophthora* in Southeast Asia. In addition, a molecular analysis of the ITS1-5.8S-ITS2 nrDNA region was included in order to determine species groups and to help delimit morphologically similar taxa.

## Materials and Methods

### *Morphological studies*

The geographic scope of the project, Southeast Asia, is circumscribed by Takhtajan's *et al.* (1986) Indomalaysian Botanical Subkingdom with a focus on the Indo-Chinese Region and the Malesian Region, including Myanmar, Thailand, Cambodia, Laos, Vietnam, Malaysia, the Philippines, New Guinea and Indonesia. Four collecting trips to Thailand, Malaysia and Indonesia in January and June/July of 2004 and 2005, yielded 82 specimens of *Crinipellis*, three specimens of *Chaetocalathus* and two specimens of *Moniliophthora*. Seventy-eight collections were borrowed from other herbaria, including type specimens. Voucher material and duplicates are deposited in the Harry D. Thiers Herbarium (SFSU), Herbarium Bogoriense (BO) in Bogor, Java, Indonesia, the Mycology Lab, Institute Biology of Science, Faculty of Science, University of Malaya (KLU-M) in Malaysia and Chiang Mai University (CMU) in Chiang Mai, Thailand. In the field, appropriate macromorphological characters were documented, including shape, size, color and surface features of the pileus and stipe, context and lamellae features, presence or absence of rhizomorphs, and substrate type. Color terms and notations in parentheses are from Kornerup and Wanscher (1978). Micromorphological characters were described from collected specimens and specimens borrowed from other herbaria. These characters include size, shape, color and reaction to Melzer's reagent of the basidiospores, cheilocystidia, pleurocystidia, pileipellis, stipitipellis and trama. Microscopic terms are those of Largent (1986), Largent *et al.* (1977) and Vellinga (1988). The pileipellis of *Crinipellis* species is formed from a cutis of terminal skeletal hyphae, herein called *hairs*, arising from chains of thinner-walled generative hyphae herein called *subtending hyphae*. All measurements and colors reported for microscopic features were made from dried material rehydrated in 100% ethanol and followed by distilled water, 3% KOH, Congo Red or Melzer's reagent. An Olympus CX41 microscope with a drawing tube was used for microscopic analysis. Basidiospore statistics include:  $x_m$ , the arithmetic mean of the spore

length and the spore width ( $\pm$  standard deviation) from  $n$  spores measured in a single specimen;  $x_{mr}$ , the range of spore means and  $x_{mm}$ , the mean of spore means ( $\pm$  SD) where more than one specimen is available;  $Q$ , the quotient of spore length and spore width in any one basidiospore indicated as a range of variation in  $n$  spores measured;  $Q_m$ , the mean of  $Q$ -values in a single specimen;  $Q_{mr}$ , the range of  $Q$  values and  $Q_{mm}$ , the mean of  $Q$  values where more than one specimen is available. Herbarium citations follow Holmgren *et al.* (1981) with the exception of the Mycology Lab, Faculty of Science, University of Malaya (KLU-M) in Kuala Lumpur, Malaysia.

In the figures, basidiomes are natural size, unless stated otherwise. Figures for basidiospores, basidia, basidioles, cystidia, pileipellis hairs, and caulocystidia are at 1000x (scale bar = 10  $\mu$ m), unless stated otherwise.

### *Molecular techniques*

DNA was extracted from recently collected dried specimens and herbarium collections using either the E.Z.N.A. Forensic DNA Kit (D3591-01) or Fungal Mini Kit (D3390-01) from Omega Bio-tek, Inc. (P.O. Box 47310, Doraville, GA 30362). Primers used for DNA amplification and sequencing were ITS1, ITS2, ITS3, ITS4 (White *et al.*, 1990) and ITS1-F, ITS4-B (Gardes and Bruns, 1993). PCR and cycle sequencing reactions followed standard protocols and were performed on ABI 9600 thermal cyclers. Sequencing reactions were run on an ABI 377 and ABI 3100 Genetic Analyzer (Applied Biosystems, Foster City, CA, USA). Sequences were edited and contigs assembled using Sequencher version 3.1.1 (Gene Codes Corporation, Ann Arbor, Michigan) software.

### *Phylogenetic analysis*

Alignment was performed with ClustalX (1.81) (Thompson *et al.*, 1997) and by hand using MacClade 4.03PPC (Maddison and Maddison, 2001). Maximum parsimony (MP) and Maximum Likelihood (ML) analyses were performed with PAUP\* v. 4.0b10 (PPC) (Swofford, 2002) with equal weighting and gaps treated as missing data. Seventy-one sequences are included in the data set,

including nine previously published sequences downloaded from GenBank. In addition to the *Crinipellis* species, *Chaetocalathus*, *Moniliophthora* and *Marasmius sensu stricto* are also included, with a *Marasmius crinis-equi* F. Muell. ex Kalchbr. specimen from Malaysia as the outgroup. A Maximum parsimony heuristic search was performed with stepwise addition as random with 100 replicates and TBR branch swapping. A bootstrap analysis was performed with 500 replicates with stepwise addition as random with 10 replicates, keeping no more than 100 trees per replicate and TBR branch swapping. Modeltest 3.06 (Posada and Crandall, 1998) was used to identify an optimal model of evolution for the ML analysis. Akaike Information Criterion (AIC) Model selected TVM+I+G model, a sub-model of the GTR model. A ML bootstrap analysis was performed with 500 replications in GARLI (Zwickl, 2006). Bayesian analyses were performed using MrBayes 3.1.2 (Huelsenbeck and Ronquist, 2001; Ronquist and Huelsenbeck, 2003). MrModeltest 2.2 (Nylander, 2004) was used to determine the best evolutionary model (GTR + I + G) following the AIC criterion. Two independent analyses of 1 000 000 generations were run keeping one tree every 1000 generations. The burn-in value was set to 25% and the remaining trees were used to calculate a 50% majority rule consensus tree and to determine the posterior probabilities (PP).

Sequences generated as part of this project are listed in Table 1 and were deposited in GenBank (accession numbers FJ167608-FJ167669). The alignment was submitted to TreeBase (SN4057). MycoBank numbers are provided for all new species (MB 512271 – MB 512277).

## Results

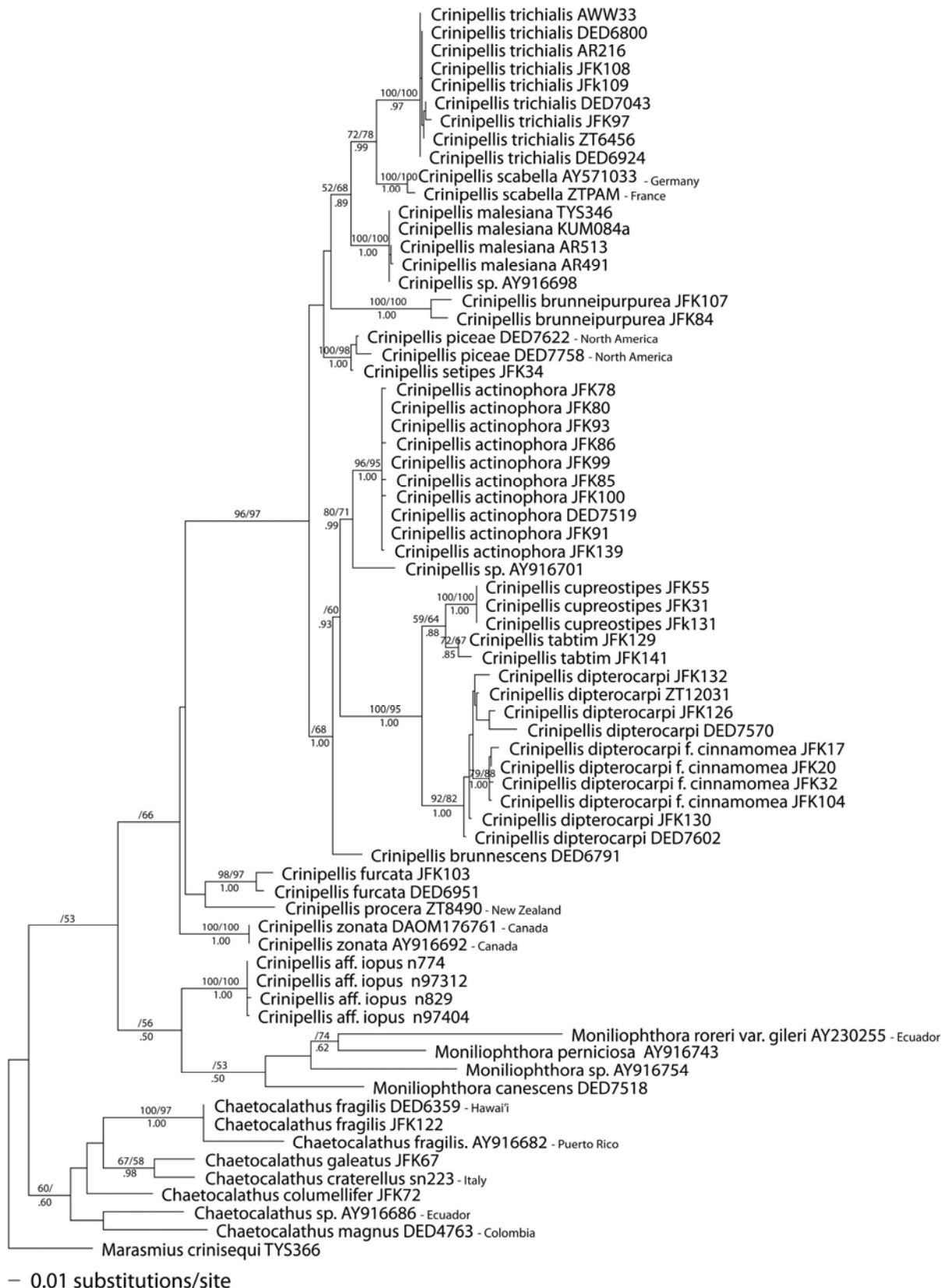
### *Phylogenetic analyses*

The final data set was 907 base pairs in length. Ambiguously aligned regions in the alignment (bp 120-200 in ITS1 and 620-800 in ITS2) were excluded from the analysis. In the final data set, 657 characters were included with 196 parsimony informative characters and 338 constant characters. The MP analysis resulted in 6,600 most equally parsimonious

trees of 752 steps. A phylogram tree produced by the ML analysis (-lnL = 4516.5117) is shown in Fig. 1. Both the MP and ML analyses resulted in the same topology and relationships for the species groups (except for *C. brunnescens*, *C. brunneipurpurea*, *C. aff. iopus* and the clade containing *C. piceae* and *C. setipes*). The 50% majority rule consensus tree resulting from the Bayesian analysis is also similar in overall topology although it did not resolve all of the species groups. There is no significant bootstrap (BS) or posterior probability (PP) support for the *Crinipellis* clade (excluding *C. aff. iopus*) in the MP or Bayesian analyses, however, there was 66% BS support in the ML analysis. Four *Moniliophthora* species formed a clade but with limited statistical support (53% ML-BS, .50 PP). *Moniliophthora* was sister of *Crinipellis* aff. *iopus* but with limited statistical support (56% ML-BS, .50 PP). Seven species of *Chaetocalathus* formed a clade but with limited statistical support (60% MP-BS, .60 PP) and were sister to *Crinipellis* + *Moniliophthora* but without statistical support. The maximum parsimony analysis resulted in *Moniliophthora* sister to *Crinipellis* + *Chaetocalathus*. The ITS region resolved species groups with high statistical support. MP bootstrap values of  $\geq 92\%$ , ML bootstrap values of  $\geq 82\%$ , and PP values of  $\geq .97$  delimited species groups, with the exception of *C. tabtim* (72% MP-BS, 67% ML-BS, .85 PP). The type species of *Crinipellis*, *C. scabellata*, was sister of *C. trichialis* with 72% MP-BS, 78% ML-BS and .99 PP support. Twelve species of Southeast Asian *Crinipellis* were resolved in the molecular analysis although the relationships amongst them usually received low statistical support.

### Discussion of phylogenetic data

The nrITS region successfully resolved species groups and aided in distinguishing morphologically similar taxa. However, due to the high variability of the region, the ITS sequence data were not able to resolve the nodes delimiting crinipelloid genera nor were they able to resolve the phylogenetic relationships between species with significant statistical support. Other analyses using



**Fig. 1.** Maximum likelihood tree (-lnL = 4516.5117) inferred from nrITS sequence data. Numbers indicate parsimony bootstrap values  $\geq 50\%$  followed by ML bootstrap values and with posterior probabilities below the branch.

**Table 1.** List of specimens used in the molecular analyses.

Species	Origin	Collection number (herbarium)*	GenBank accession number
<i>Crinipellis actinophora</i>	Malaysia	DED7519 (KLU-M)	FJ167624
<i>C. actinophora</i>	Malaysia	JFK78 (KLU-M)	FJ167617
<i>C. actinophora</i>	Malaysia	JFK80 (KLU-M)	FJ167618
<i>C. actinophora</i>	Malaysia	JFK85 (KLU-M)	FJ167622
<i>C. actinophora</i>	Malaysia	JFK86 (KLU-M)	FJ167620
<i>C. actinophora</i>	Malaysia	JFK91 (KLU-M)	FJ167625
<i>C. actinophora</i>	Malaysia	JFK93 (KLU-M)	FJ167619
<i>C. actinophora</i>	Malaysia	JFK99 (KLU-M)	FJ167621
<i>C. actinophora</i>	Malaysia	JFK100 (KLU-M)	FJ167623
<i>C. actinophora</i>	Malaysia	JFK139 (CMU)	FJ167626
<i>C. brunneipurpurea</i>	Indonesia	JFK84 (KLU-M)	FJ167646
<i>C. brunneipurpurea</i>	Indonesia	JFK107 (KLU-M)	FJ167645
<i>C. brunnescens</i>	Indonesia	DED6791 (BO)	FJ167627
<i>C. cupreostipes</i>	Thailand	JFK31 (CMU)	FJ167641
<i>C. cupreostipes</i>	Thailand	JFK55 (CMU)	FJ167640
<i>C. cupreostipes</i>	Thailand	JFK131 (CMU)	FJ167642
<i>C. dipterocarpi</i>	Thailand	DED7570 (SFSU)	FJ167656
<i>C. dipterocarpi</i>	Thailand	DED7602 (SFSU)	FJ167651
<i>C. dipterocarpi</i>	Thailand	JFK126 (CMU)	FJ167655
<i>C. dipterocarpi</i>	Thailand	JFK130 (CMU)	FJ167650
<i>C. dipterocarpi</i>	Thailand	JFK132 (CMU)	FJ167647
<i>C. dipterocarpi</i>	Indonesia	ZT12031 (BO)	FJ167654
<i>C. dipterocarpi</i> f. <i>cinnamomea</i>	Malaysia	JFK17 (KLU-M)	FJ167648
<i>C. dipterocarpi</i> f. <i>cinnamomea</i>	Malaysia	JFK20 (KLU-M)	FJ167653
<i>C. dipterocarpi</i> f. <i>cinnamomea</i>	Thailand	JFK32 (CMU)	FJ167649
<i>C. dipterocarpi</i> f. <i>cinnamomea</i>	Indonesia	JFK104 (BO)	FJ167652
<i>C. furcata</i>	Indonesia	DED6951 (BO)	FJ167658
<i>C. furcata</i>	Indonesia	JFK103 (BO)	FJ167657
<i>C. aff. iopus</i>	Papua New Guinea	RW829 (GENT)	FJ167638
<i>C. aff. iopus</i>	Papua New Guinea	RW774 (GENT)	FJ167636
<i>C. aff. iopus</i>	Papua New Guinea	AV97/312 (GENT)	FJ167637
<i>C. aff. iopus</i>	Papua New Guinea	AV97/404 (GENT)	FJ167639
<i>C. malesiana</i>	Indonesia	AR491 (BO)	FJ167631
<i>C. malesiana</i>	Indonesia	AR513 (BO)	FJ167630
<i>C. malesiana</i>	Malaysia	KUM084a (KLU-M)	FJ167629
<i>C. malesiana</i>	Malaysia	TYS346 (KLU-M)	FJ167628
<i>C. piceae</i>	North America	DED7622 (SFSU)	FJ167632
<i>C. piceae</i>	North America	DED7758 (SFSU)	FJ167633
<i>C. procera</i>	New Zealand	ZT8490 (ZT)	FJ167660
<i>C. setipes</i>	Thailand	JFK34 (CMU)	FJ167634
<i>C. scabella</i>	France	ZTPAM98 (ZT)	FJ167635
<i>C. scabella</i>	Germany	PB302	AY571033
<i>C. tabtim</i>	Thailand	JFK129 (CMU)	FJ167643
<i>C. tabtim</i>	Thailand	JFK141 (CMU)	FJ167644
<i>C. trichialis</i>	Indonesia	AWW33 (BO)	FJ167608
<i>C. trichialis</i>	Indonesia	AR216 (BO)	FJ167610
<i>C. trichialis</i>	Indonesia	DED6800 (SFSU)	FJ167609
<i>C. trichialis</i>	Indonesia	DED6924 (SFSU)	FJ167613
<i>C. trichialis</i>	Indonesia	DED7043 (SFSU)	FJ167614
<i>C. trichialis</i>	Malaysia	JFK97 (SFSU)	FJ167616
<i>C. trichialis</i>	Indonesia	JFK108 (BO)	FJ167611
<i>C. trichialis</i>	Indonesia	JFK109 (BO)	FJ167612
<i>C. trichialis</i>	Indonesia	ZT6456 (ZT)	FJ167615

**Table 1(continued).** List of specimens used in the molecular analyses.

Species	Origin	Collection number (herbarium)*	GenBank accession number
<i>C. zonata</i>	Canada	DAOM176761 (SFSU)	FJ167659
<i>C. zonata</i>	Canada	OKM25450 (VPI)	AY916692
<i>C. sp.</i>	Thailand	OKM26890 (VPI)	AY916698
<i>C. sp.</i>	Guyana	MCA1527 (BPI)	AY916701
<i>Chaetocalathus craterellus</i>	Italy	SN223 (ZT)	FJ167664
<i>C. fragilis</i>	Hawai'i	DED6359 (SFSU)	FJ167661
<i>C. fragilis</i>	Thailand	JFK122 (SFSU)	FJ167662
<i>C. galeatus</i>	Thailand	JFK67 (SFSU)	FJ167663
<i>C. liliputianus</i>	Puerto Rico	MCA485 (BPI)	AY916682
<i>C. magnus</i>	Colombia	DED4763(SFSU)	FJ167666
<i>C. columellifer</i>	Malaysia	JFK72 (SFSU)	FJ167665
<i>C. sp.</i>	Ecuador	MCA2538 (BPI)	AY916686
<i>Moniliophthora canescens</i>	Malaysia	DED7518 (SFSU)	FJ167668
<i>M. pernicioso</i>	Ecuador	MCA 2520 (BPI)	AY916743
<i>M. roreri</i> var. <i>gileri</i>	Ecuador	DIS 331	AY230255
<i>M. sp.</i>	North America	MCA 2500 (BPI)	AY916754
<i>Marasmiellus subochraceus</i>	Malaysia	DED7523 (SFSU)	FJ167667
<i>Marasmius crinisequi</i>	Malaysia	TYS366 (KLU-M)	FJ167669

\* All available duplicates are deposited at SFSU.

multigene datasets (Aime and Phillips-Mora 2005) successfully delimited *Crinipellis*, *Moniliophthora* and *Chaetocalathus* with high statistical support.

Some interesting observations regarding character evolution can be made. For example, cheilocystidia shape may be a phylogenetically informative character. The clade containing *C. trichialis*, *C. malesiana* and the type of the genus, *C. scabella* (= *C. stipitaria*), supported with 52% MP-BS, 68% ML-BS and .89 PP values all have simple cheilocystidia. The clade consisting of *C. actinophora*, *C. cupreostipes*, *C. tabtim*, *C. dipterocarpi*, *C. dipterocarpi* f. *cinnamomea* and *C. brunnescens*, supported with 68% ML-BS and 1.0 PP values all have cheilocystidia with numerous knob-like apical appendages. Pileipellis anatomy is also an informative feature. Species with few pileus hairs that arise from chains of short, broad, pigment-incrusted cells and typically have no KOH reaction, as represented in the phylogenetic tree by *C. aff. iopus* and *Moniliophthora* species, formed a distinct clade in most analyses, although with limited support.

This study did not attempt to test the phylogenetic validity of Singer's (1943, 1976) infrageneric delimitation of *Crinipellis*. In order to do that, one would need to include the type species of each section in molecular analyses and use a broad global sampling of species. However, based on our ITS dataset

analyses of primarily Southeast Asian *Crinipellis*, it appears that Singer's infrageneric classification is not supported. For example, *C. trichialis* is placed in the section *Grisentinae* based on the reaction of the pileus hairs turning grey to green in KOH. Two new species, *C. malesiana* and *C. brunnescens* would belong in this section based on this KOH reaction criterion; however, in both the MP and ML analyses, these three species do not fall into the same clade. In addition, *C. scabella*, the type of section *Crinipellis* and characterized by a negative KOH reaction, is nested in the clade with *C. trichialis* and *C. malesiana*. Although hyphal reactions in KOH are taxonomically informative and aid in species delimitations, they do not appear to be particularly useful in determining phylogenetic relationships.

In summary, the molecular data resolved 12 species of Southeast Asian *Crinipellis* with relatively high bootstrap support. Seven species of Southeast Asian *Crinipellis* are not represented in the molecular analyses: *C. aff. mirabilis*, *C. atrobrunnea*, *C. carecomoeis* var. *litseae*, *C. cervino-alba*, *C. hepatica*, *C. pseudostipitaria* subsp. *orientalis*, and *C. sepiaria*. Of the 19 species of Southeast Asian *Crinipellis* recognized in this monograph, five species and one form are new to science (32%). This study also expanded the geographic distribution of the following species: *C. actinophora*, *C. brunneipurpurea*, *C. diptero-*

*carpi*, *C. aff. iopus*, *C. aff. mirabilis*, *C. setipes* and *C. trichialis*, along with expanding the known distribution of the genera *Crinipellis* and *Moniliophthora*. Two species of *Crinipellis* are formally transferred to the genus *Moniliophthora*, one new species of *Moniliophthora* is described from Malaysia, and one species of *Crinipellis* is formally transferred to the genus *Marasmiellus* Murrill. In addition, 23 holotype studies are presented. Future molecular analyses using multiple genes and a global sample set will help resolve the phylogenetic relationships amongst the crinipelloid genera.

### Synopsis of Southeast Asian *Crinipellis*

1. *Crinipellis actinophora* (Berk. & Broome) Singer
2. *Crinipellis atrobrunnea* Pat.
3. *Crinipellis brunneipurpurea* Corner
4. *Crinipellis brunnescens* Kerekes, Desjardin & Retn. **sp. nov.**
5. *Crinipellis carecomoeis* var. *litseae* Singer
6. *Crinipellis cervino-alba* Corner
7. *Crinipellis cupreostipes* Kerekes, Desjardin & Lumyong **sp. nov.**
8. *Crinipellis dipterocarpi* Singer
9. *Crinipellis dipterocarpi* f. *cinnamomea* Kerekes, Desjardin & Lumyong **f. nov.**
10. *Crinipellis furcata* Kerekes, Desjardin & Lumyong **sp. nov.**
11. *Crinipellis hepatica* Corner
12. *Crinipellis aff. iopus* Singer
13. *Crinipellis malesiana* Kerekes, Desjardin & Vikineswary **sp. nov.**
14. *Crinipellis aff. mirabilis* Singer
15. *Crinipellis pseudostipitaria* subsp. *orientalis* Singer
16. *Crinipellis sepiaria* Pat. et Demange
17. *Crinipellis setipes* (Peck) Singer
18. *Crinipellis tabtim* Kerekes, Desjardin & Lumyong **sp. nov.**
19. *Crinipellis trichialis* (Lév.) Pat. ex Antonín *et al.*
20. *Moniliophthora canescens* (Har. Takah.) Kerekes & Desjardin **comb. nov.**
21. *Moniliophthora marginata* Kerekes, Desjardin & Vikineswary **sp. nov.**
22. *Moniliophthora nigrilineata* (Corner) Kerekes & Desjardin **comb. nov.**
23. *Marasmiellus subochraceus* (Corner) Kerekes & Desjardin **comb. nov.**

### Excluded and Insufficiently Known Taxa, Including Relevant Type Studies of Extralimital Species.

24. *Agaricus omotrichus* Berk.
25. *Collybia multicolor* Petch
26. *Crinipellis carecomoeis* var. *subelata* Singer
27. *Crinipellis elata* Pat.
28. *Crinipellis filiformis* G. Stev.
29. *Crinipellis novae-zelandiae* G. Stev.
30. *Crinipellis patouillardii* Singer
31. *Crinipellis procera* G. Stev.
32. *Crinipellis readiae* G. Stev.
33. *Crinipellis roseola* G. Stev.
34. *Crinipellis substipitaria* G. Stev.
35. *Crinipellis velutipes* G. Stev.
36. *Crinipellis vinacea* G. Stev.

### Artificial Key to the *Crinipellis* and *Moniliophthora* species from Southeast Asia

1. Pileus brightly pigmented with shades of purple, violet brown, red to reddish-brown or ruby ..... 2
- 1.\* Pileus not brightly pigmented, with shades of brown, dull reddish brown, dark brown, black, tawny or white..... 9
2. Pileipellis hairs turning green, slate blue, grey, olive-grey or purple in KOH..... 3
- 2.\* Pileipellis hairs not reacting in KOH ..... 5
3. Pileus ruby colored; pileipellis hairs becoming slate blue in KOH..... 18. *C. tabtim*
- 3.\* Pileus violet brown, dark purple or dark reddish brown; pileipellis hairs turning grey, greyish green or midnight blue in KOH ..... 4
4. Pileus violet brown to dark purple; basidiospores 10–14 × 3–5 µm; pileipellis and stipitipellis hairs turning midnight blue in KOH ..... 3. *C. brunneipurpurea*
- 4.\* Pileus dark reddish brown to violet brown; basidiospores 8–12 × 3–5 µm; pileipellis hairs initially purple in KOH, becoming grey to olive-grey in time ..... 14. *C. aff. mirabilis*
5. Pileus lilac ..... 12. *C. aff. iopus*
- 5.\* Pileus reddish brown..... 6
6. Lamellae edge reddish brown marginate; pileus up to 22 mm diam.; pileipellis hairs subtended by chains of broad cells ..... 21. *Moniliophthora marginata*
- 6.\* Lamellae edge not marginate; pileus less than 10 mm diam; pileipellis hairs subtended by long, cylindrical tramal hyphae..... 7



7. Basidiomes associated with dead twigs of *Litsea*; basidiospores  $12.8\text{--}16.5 \times 4.5\text{--}5.8 \mu\text{m}$ ; pileus cinnamon buff to tawny olive..... 5. *C. carecomoeis* var. *litseae*
- 7.\* Basidiomes not associated with *Litsea*; basidiospores in the range  $6\text{--}11 \times 3\text{--}5.5 \mu\text{m}$ ; pileus brown rufous to reddish brown or cinnamon ..... 8
8. Pileus brown rufous to liver-rufous; cheilocystidia subventricose to subfusiform and without appendages; stipe pallid to pinkish ochraceous or bright rufous.....11. *C. hepatica*
- 8.\* Pileus reddish brown to cinnamon colored; cheilocystidia clavate with 1–10 appendages; stipe reddish brown.... 9. *C. dipterocarpi* f. *cinnamomea*
9. (1\*) Stipe and abundant rhizomorphs both brownish orange to copper coloured; stipe 40–550 mm in length ..... 7. *C. cuprestipes*
- 9.\* Stipe (and rhizomorphs if present) dark brown to black, never copper-coloured; stipe typically less than 50 mm long (rarely up to 100 mm)..... 10
10. Basidiomes associated with Poaceae..... 11
- 10.\* Basidiomes not associated with Poaceae..... 14
11. Basidiomes associated with bamboo ..... 12
- 11.\* Basidiomes associated with other grasses ..... 13
12. Basidiospores  $5.7\text{--}7.7 \times 4.5\text{--}5.7 \mu\text{m}$  ( $x_m = 6.6 \times 5.2 \mu\text{m}$ ); pileus bister to grey, usually azonate with strigose, radial repent hairs; pileipellis hairs not turning green in KOH..... 16. *C. sepiaria*
- 12.\* Basidiospores  $9.6\text{--}11.5 \times 6\text{--}7 \mu\text{m}$  ( $x_m = 10.3 \times 6.5 \mu\text{m}$ ); pileus dark brown with pale brown margin and distinct concentric zones with erect hairs; pileipellis hairs turning green in KOH ..... 19. *C. trichialis*
13. (11\*) Basidiospores  $10\text{--}12.5 \times 5.2\text{--}6 \mu\text{m}$  ( $x_m = 11.1 \times 5.6 \mu\text{m}$ ); pileus dark brown to black ..... 2. *C. atrobrunnea*
- 13.\* Basidiospores  $7.7\text{--}9.5 \times 5\text{--}6 \mu\text{m}$  ( $x_m = 8.3 \times 5.5 \mu\text{m}$ ); pileus tan to brown ..... 15. *C. pseudostipitaria* subsp. *orientalis*
14. (10\*) Pileipellis hairs or stipitipellis tissues turning green, olive green, or light brown to green in KOH ..... 15
- 14.\* Pileipellis or stipe hairs not reacting in KOH..... 18
15. Lamellae staining dark brown to black when bruised and with age.....4. *C. brunnescens*
- 15.\* Lamellae not staining dark brown to black ..... 16
16. Rhizomorphs abundant, grey, greyish brown to dark brown and distinctly coarse, very few black and wiry rhizomorphs present.....1. *C. actinophora*
- 16.\* Rhizomorphs absent or consistently thin and wiry, black, never grey ..... 17
17. Basidiomes robust, with pileus 2–13 mm diam; pleurocystidia present; pileus hairs and stipe tissue initially yellowish green to green in KOH, remaining so in time; rhizomorphs absent ..... 13. *C. malesiana*
- 17.\* Basidiomes not robust, with pileus 1–5 mm diam; pleurocystidia absent; pileus hairs initially purple in KOH, becoming grey to olive-greyish in time; rhizomorphs present..... 14. *C. aff. mirabilis*
18. (14\*) Basidiomes associated with dead twigs of *Litsea*; basidiospores  $12.8\text{--}16.5 \times 4.5\text{--}5.8 \mu\text{m}$  ( $x_m = 13.5 \times 5.1 \mu\text{m}$ )..... 5. *C. carecomoeis* var. *litseae*
- 18.\* Basidiomes not associated with *Litsea*; basidiospores smaller, in the range  $5\text{--}12.8 \times 2\text{--}6 \mu\text{m}$  ( $x_{mr} = 7.4\text{--}11.2 \times 3.0\text{--}4.7 \mu\text{m}$ )..... 19
19. Cheilocystidia with more than 3 apical appendages (if verrucose, see 22); rhizomorphs present, reddish brown, dark brown or black ..... 20
- 19.\* Cheilocystidia absent or if present simple (lacking apical appendages), rarely verrucose, forked, or with 1–3 apical appendages; rhizomorphs absent or if present black, thin and wiry..... 22
20. Basidiomes associated with woody debris; basidiospores  $x_m = 8.2 \times 4.5 \mu\text{m}$ ,  $Q_m = 1.9$  ..... 17. *C. setipes*
- 20.\* Basidiomes associated with decomposing leaves, rarely twigs; basidiospores  $x_{mnr} = 8.6\text{--}8.8 \times 4.0 \mu\text{m}$ ,  $Q_{mm} = 2.2$  ..... 21
21. Pileus light brown to dark brown ..... 8. *C. dipterocarpi*
- 21.\* Pileus reddish brown to cinnamon coloured ..... 9. *C. dipterocarpi* f. *cinnamomea*
22. (19\*) Cheilocystidia absent..... 23
- 22.\* Cheilocystidia simple (lacking apical appendages), forked or with 1–3 three apical appendages, rarely verrucose ..... 24
23. Pileus white with brown, powdery-fibrous patches or spots; stipe base pink ..... 23. *Marasmiellus subochraceus*
- 23.\* Pileus-clay-color to brown; stipe base dark brown ..... 22. *Moniliophthora nigrilineata*
24. Basidiomes dark brown to almost black overall; stipe squamulose, (15–)30–40 mm long; cheilocystidia typically apically forked..... 10. *C. furcata*
- 24.\* Basidiomes lighter in color; stipe fibrillose to hispidulous, 4–10 mm long; cheilocystidia not apically forked ..... 25
25. Incrustations absent on the pileipellis cells; pileus fawn-buff; species of swamp forests..... 6. *C. cervino-alba*
- 25.\* Incrustations present on the pileipellis cells; pileus brown rufous or greyish orange; species of mesic forests..... 26
26. Pileus brown rufous to liver-rufous; stipe pallid to pinkish ochraceous or bright rufous; cheilocystidia

without apical appendages .....11. *C. hepatica*  
 26.\* Pileus dull greyish orange; stipe brownish grey,  
 often arising from a thin white subiculum;  
 cheilocystidia with 0–3 apical appendages.....  
 .....20. *Moniliophthora canescens*

## Taxonomy

1. *Crinipellis actinophora* (Berk. & Broome)  
 Singer, Sydowia 9: 397. 1955.

(Figs 2:1–6, 19)

≡ *Marasmius actinophorus* Berk. & Broome, J.  
 Linn. Soc., Bot. 14: 39. 1873.

= *Marasmius coronatus* Petch, Ann. Roy. Bot.  
 Gard., Peradeniya 6: 58. 1915.

Type: Sri Lanka, G.H.K. Thwaites 1164  
 [K #122107].

*Analysis of the holotype specimen:*

The holotype specimen consists of one  
 basidiome in poor condition, pressed flat and  
 glued to a card. As dried: *Pileus* 4 mm diam,  
 plano-convex with a circular depression (zone)  
 around a central papilla, radially shaggy, dark  
 brown. *Lamellae* not observable. *Stipe* 8 × 0.5  
 mm, base broken off, fibrillose, dark brown.

Few hymenial elements observable;  
 material revives poorly. *Basidioles* subfusoid.  
 No spores, cystidia or basidia observed.  
*Pileipellis* of agglutinated, subparallel, thin- to  
 thick-walled hairs; *hairs* > 300 × 3.2–6(–10)  
 μm, cylindrical, ± equal for most their length,  
 obtuse, with scattered secondary septa; walls  
 0.5–2 μm thick, yellowish brown, dextrinoid,  
 non-incrusted; yellowish olive in KOH.

### Description based on fresh material

*Pileus* (2–)4–10 mm diam., paraboloid  
 with incurved margins, subumbilicate with a  
 raised concentric ridge around disc and a  
 distinct papilla when young, becoming convex  
 to plano-convex, subumbonate with an acute  
 papilla and raised concentric zones around the  
 disc in age, dull, dry, with radially appressed-  
 fibrillose hairs forming tufts that hang below  
 margin edge; disc and papilla dark brown  
 (6F6–7), becoming brown (6E6) to greyish  
 brown (6D3) or cream at margin in age.  
*Context* < 1 mm thick, white to cream,  
 unchanging. *Lamellae* narrowly adnexed to  
 free, subdistant to close with a few appearing  
 crowded, with 2–3 series of lamellulae, white.  
*Stipe* 4–20(–35) × < 1 mm, central, terete,  
 slightly broader at base, insititious, dull, dry,  
 hirsute, ornamentation dense at base forming

upturned scales; dark brown (6F6) to brown  
 (6E6), becoming greyish brown (6D3) to cream  
 with age. *Rhizomorphs* present and abundant, 1  
 mm thick, glabrous to pubescent, grey, greyish  
 brown (6D3) to dark brown (7F5), tough, along  
 ground binding leaf litter and arising from a  
 subiculum on decomposing twigs and giving  
 rise to fruiting bodies. *Odor and taste* none.

*Basidiospores* 6–10 × 3–5 μm [ $x_{mr} =$   
 6.8–8.1 × 3.8–4.0 μm,  $x_{mm} = 7.5 ± 0.5 × 3.9 ±$   
 0.1 μm,  $Q = 1.4–2.7$ ,  $Q_{mr} = 1.7–2.1$ ,  $Q_{mm} = 1.9$   
 ± 0.1;  $n = 10–25$  spores per 20 collections],  
 ellipsoid, smooth, hyaline, inamyloid, thin-  
 walled. *Basidia* 16–22 × 5–6 μm, clavate, 4-  
 spored. *Basidioles* clavate to cylindrical with  
 rounded to subacute apex. *Pleurocystidia*  
 absent. *Cheilocystidia* common, lamellar edge  
 sterile; main body 14–25 × 3–10 μm,  
 cylindrical to clavate or irregular, hyaline,  
 inamyloid, thick-walled; apical appendages (3–)  
 6 to numerous, 1–4(–15) × 0.5–3 μm, knobby  
 to finger-like, hyaline, inamyloid, thin walled;  
 a few collections with hardened crystal  
 exudates on longer projections. *Pileipellis* a  
 cutis, hyphae 24–40 × 4–15 μm, hyaline,  
 slightly dextrinoid, with dextrinoid spiral  
 incrustations, clamped, giving rise to terminal  
 hairs. *Hairs* 180–750 × 3–6 μm, hyaline to  
 light brown in water and KOH, dextrinoid,  
 thick-walled (up to 2 μm), apices bluntly  
 rounded or tapering, with secondary septations.  
*Pileus trama* subregular; hyphae 3–8 μm diam.,  
 cylindrical, smooth, hyaline, inamyloid, thin-  
 walled. *Lamellar trama* regular; hyphae 3–8  
 μm diam., cylindrical, smooth, hyaline,  
 inamyloid, thin-walled. *Stipe tissue* monomitic,  
 parallel, tightly packed; *stipitipellis* composed  
 of repent cortical hyphae, terminal hairs and  
 caulocystidia; *cortical hyphae* 2–2.5 μm diam.,  
 cylindrical, slightly thick-walled, dextrinoid,  
 brown in water, becoming green in KOH;  
*medullary hyphae* 1.5–3 μm diam., cylindrical,  
 slightly thick-walled, dextrinoid, hyaline to  
 light green in KOH; *caulocystidia* 50–138 × 10  
 μm, cylindrical, hyaline, slightly dextrinoid,  
 slightly thick-walled; *terminal hairs* 38–460 ×  
 2.5–8 μm, hyaline to tan in water and KOH,  
 dextrinoid, thick-walled, with secondary  
 septations. *Clamp connections* present.

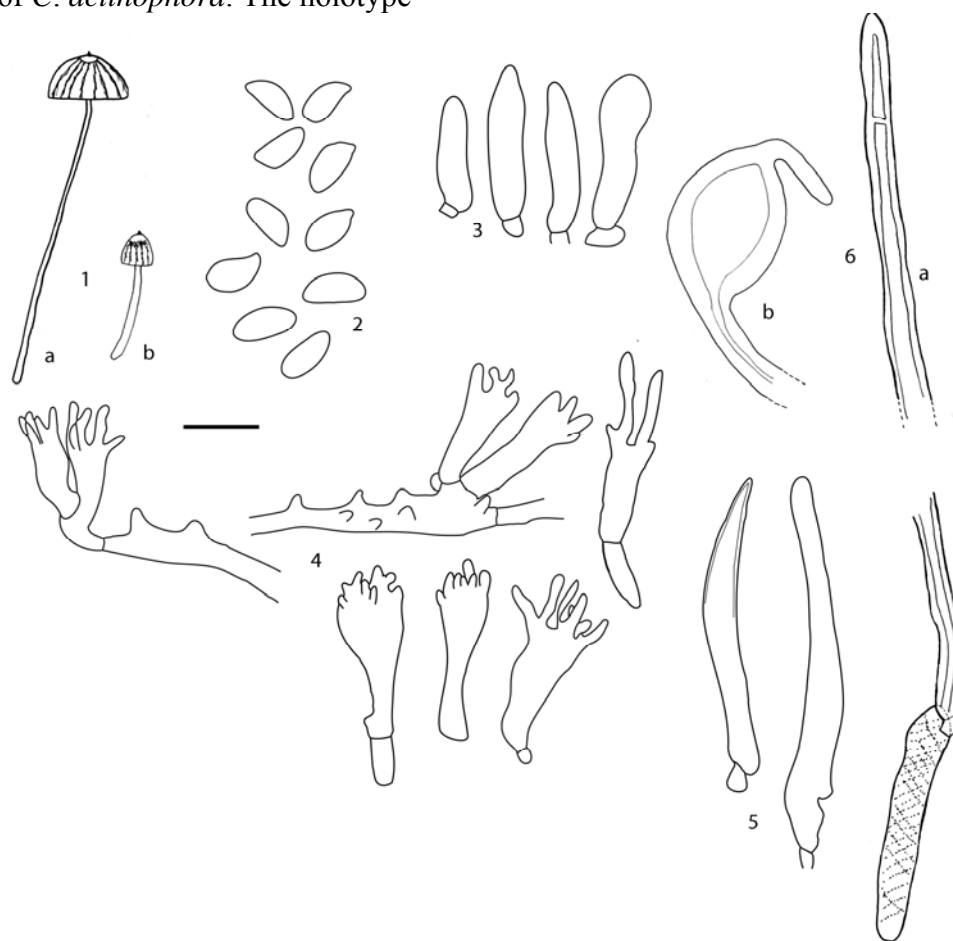
*Habitat:* Primarily on decomposing twigs  
 and few found on decomposing dicot leaves.

**Known distribution:** Malaysia, Thailand, Sri Lanka, and Singapore.

**Material examined:** MALAYSIA. Kuala Lumpur, Gombak Field Station, 12 January 2003, D. E. Desjardin 7519 (KLU-M, SFSU); Selangor, Hulu Langat, Sungai Chongkak Forest Reserve, N03°12.705', E101°50.472', elev. 188 m, 7 January 2005, Kerekes 78 (KLU-M, SFSU); same location, 7 January 2005, Kerekes 79 (KLU-M, SFSU); same location, Kerekes 80 (KLU-M, SFSU); Selangor, Selayang, Kanching Forest Reserve, N03°17.954', E101°37.153', elev.  $\pm$  110 m, 8 Jan 2005, Kerekes nos. 85, 86, 87, 88, 89, 90, 91, 92, 93 (KLU-M, SFSU); same location, 9 Jan 2005, Kerekes nos. 95, 96, 98, 99, 100 (SFSU). SRI LANKA, G.H.K. Thwaites 1164 [**Holotype** of *Marasmius actinophorus*: K #122107]; Hakgala, January 1914, coll. by T. Petch 3923, on bark [**Holotype** of *Marasmius coronatus*: K #122106]; Hakgala, T. Petch 2227, April 1917 [K #122108]; Nuwara Eluya District, Hakgala Botanic Garden, 29 October 1974, D.N. Pegler 2131 [K #122111]. THAILAND, Nakorn Nayok Province, Khao Yai National Park, Orchid Waterfall trail, 8 July 2005, Kerekes 139 (CMU, SFSU).

**Notes:** The Malaysian and Thai specimens match nicely with both Corner (1996) and Pegler's (1986) descriptions and collections of *C. actinophora*. The holotype

was examined, however, many taxonomically important features were not recovered. Petch (1915) described *Marasmius coronatus* as a new species but later recognized it to be the same as *Marasmius actinophorus*. The coarse grey rhizomorphs distinguish this species from other *Crinipellis*, along with an obvious papilla in the disc and cheilocystidia with numerous short apical appendages. Another characteristic is the reaction of stipe tissue turning green in KOH, which was not previously noted. The rhizomorphs in the collections varied from being coarse, grey and pubescent to being thinner, black and glabrous. It may be the case that the black rhizomorphs are not associated with *C. actinophora*, but rather are from a species of *Marasmius*. No fruiting bodies were observed arising from the thin black rhizomorphs. Occasionally large inflated terminal hairs were observed in the pileipellis as seen in Fig. 2:6b. Vizzini *et al.* (2007) also observed these types of cells in *C. pedemontana* Vizzini, Antonín & Noordel., a



**Fig. 2.** *Crinipellis actinophora* (JFK 85). 1. Basidiomes (a. x2. – b. x1). – 2. Basidiospores (JFK 98). – 3. Basidioles. – 4. Cheilocystidia (JFK 78, 85, 98). – 5. Caulocystidia. – 6a-b. Pileipellis hairs. – Bar: 2-4 = 10  $\mu$ m; 5,6a = 25  $\mu$ m; 6b = 20  $\mu$ m.

species from Italy, and referred to them as chlamydocytes. *Crinipellis actinophora* was generally collected in lowland areas with elevation ranging from 110–250 m, with the exception of the single Thailand specimen collected at 730 m.

**2. *Crinipellis atrobrunnea* Pat., J. Bot. (Morot) 5: 308. 1891. (Fig. 3: 1–2)**

≡ *Marasmius atrobrunneus* (Pat.) Sacc., Syllog. Fung. 11: 38. 1895.

*Type*: TONKIN (VIETNAM), Prov. Hanoi, Ke So, 31 May 1890, coll. by Bon #4362 (Holotype and Isotype: FH!).

*Macromorphological description adapted from the protologue and Singer (1943)*:

*Pileus* 1–10 mm diam., convex, with sinuous to crenulate margin, dark brown to black. *Lamellae* subfree to adnate, subdistant to distant, thick, unequal, with at least 1 series of lamellulae, anastomosing-venose, brown to grey. *Stipe* 10–30 × 0.5–1 mm, equal or subequal, roughly hairy-sulcate, dark brown to black.

***Micromorphological description based on analysis of the holotype specimen***

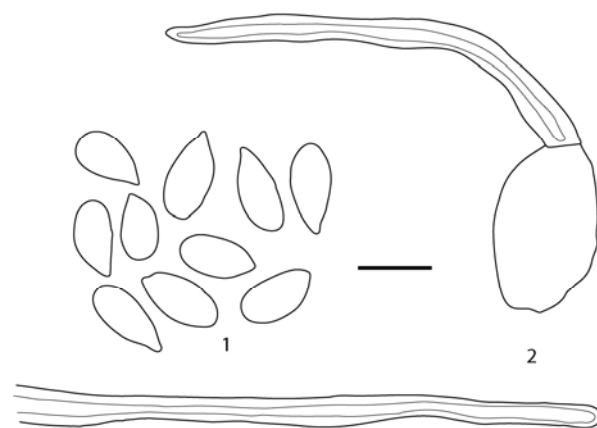
*Basidiospores* (9.3–)10–12.5 × 5.2–6 μm [ $x_m = 11.1 \pm 0.1 \times 5.6 \pm 0.2 \mu m$ ,  $Q = 1.8–2.3$ ,  $Q_m = 2.0 \pm 0.2$ ,  $n = 11$  spores per 1 collection], elongate-ellipsoid to subfusoid, smooth, hyaline, inamyloid, thick-walled. *Basidia* not observed. *Pleurocystidia* absent. *Cheilocystidia* not observed: no intact lamellar edges available for examination. *Pileipellis* a cutis of inflated, thin-walled, clamped, hyphae giving rise to thick-walled terminal hairs. *Hairs* 48–160(–200) × 3.5–5 μm, cylindrical, obtuse, hyaline to pale yellowish brown, dextrinoid.

*Habitat*: On grasses.

*Known Distribution*: Vietnam.

*Material examined*: *Type*: TONKIN (VIETNAM), Prov. Hanoi, Ke So, 31 May 1890, coll. by Bon #4362 (**Holotype**: FH).

*Notes*: Our type analysis matches that of Yang (2000: 446). This represents a species of *Crinipellis*, distinctive because of the relatively long and narrow spores, short pileipellis hairs and growth on grasses. Singer (1943) reports the cheilocystidia to be 19–45 × 3.5–6 μm, cylindrical to subfusoid, with a sinuose-wavy outline and he did not observe branching.



**Fig. 3.** *Crinipellis atrobrunnea* Pat. (Holotype). – 1. Basidiospores. – 2. Pileipellis hairs. – Bar: 1-2 = 10 μm.

Unfortunately, this species was not included in the molecular analysis because DNA extraction from the type specimen was not permitted and no fresh material was encountered.

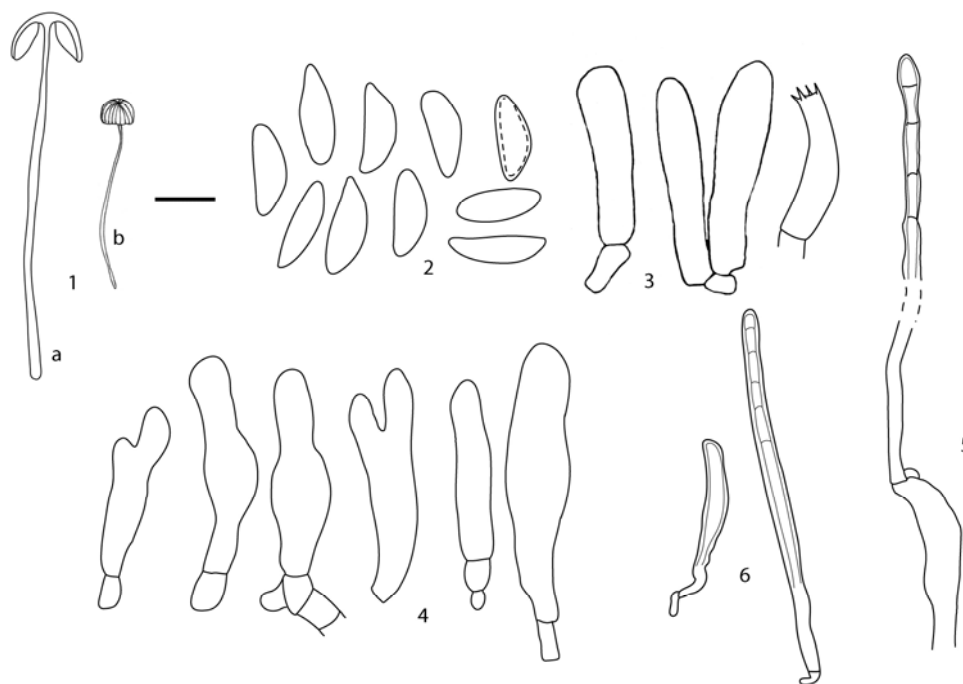
**3. *Crinipellis brunneipurpurea* Corner, Beih. Nova Hedwigia 111: 118. 1996.**

(Figs 4: 1–6, 19)

*Type*: Singapore, Gardens Jungle, Corner s.n. 14 August 1940, herb. Corner (E).

*Pileus* 3–7 diam. × 2–7 mm tall, hemispherical to convex with a small umbilicus and central papilla when young, becoming convex to broadly plano-convex, subumbilicate with a central papilla, radially appressed-fibrillose, with hairs hanging from margin edge, with raised concentric ridges around disc on some pilei; violet brown (10–11F7) to dark ruby (12F4) or dark purple (14F4) with a lighter colored disc. *Context* < 1 mm thick, white to concolorous with pileus (12F4). *Lamellae* adnexed to free, close to subdistant, with 1–3 series of lamellulae, white, staining purplish red to pinkish purple where bruised. *Stipe* 6–33 × 1–2 mm, central, cylindrical, with slightly twisted, fibrillose hairs forming tufts near the base, with longitudinal intertwining furrows above, tough; violet brown (10F7) to dark ruby (12–14F4) overall. *Rhizomorphs* absent but described as pale, thread-like mycelium on the surface of twigs and leaves by Corner (1996). *Odor and taste* none.

*Basidiospores* 10–14 × 3–5 μm [ $x_{mr} = 11.6–12.3 \times 4.1–4.3 \mu m$ ,  $x_{mm} = 12.0 \pm 0.5 \times 4.2 \pm 0.1 \mu m$ ,  $Q = 2.2–4.7$ ,  $Q_{mr} = 2.7–3.1$ ,  $Q_{mm} = 2.9 \pm 0.2$ ;  $n = 25$  spores per 2 collections], subcylindrical to fusiform or narrowly



**Fig. 4.** *Crinipellis brunneipurpurea* (JFK 107). – 1. Basidiomes (a. x2. – b. x1). – 2. Basidiospores. – 3. Basidia and Basidioles. – 4. Cheilocystidia. – 5. Pileipellis hair. – 6. Caulocystidia. Bar: 2-4 = 10  $\mu$ m; 5 = 20  $\mu$ m; 6 = 25  $\mu$ m.

amygdaliform with acute apex in side view, smooth, hyaline, inamyloid, thin- to thick-walled. *Basidia* 18–30  $\times$  5–7  $\mu$ m, clavate, 4-spored. *Basidioles* clavate, few with subacute apex. *Pleurocystidia* absent. *Cheilocystidia* common; main body (12–)20–30(–35)  $\mu$ m, clavate to irregularly clavate with occasional small knobs or bifurcating apical appendages, hyaline, inamyloid, thin- to thick-walled; apical appendages 3–7  $\mu$ m long, knobby, hyaline, inamyloid, thin-walled; repent hyphae along edge of gill 1–3  $\mu$ m diam., hyaline, inamyloid, thin-walled, septate, clamped, in some instances giving rise to cheilocystidia. *Pileipellis* a cutis, with inflated cells 30–40  $\times$  6–7  $\mu$ m diam, hyaline, dextrinoid, giving rise to terminal hairs with basal clamp connections. *Hairs* 62–412  $\times$  2.5–5  $\mu$ m, cylindrical, majority of apices rounded, secondary septa abundant, base of hairs often wavy, violet in water, becoming midnight blue in KOH, dextrinoid, thick-walled. *Pileus trama* regular to subregular; hyphae 3–7  $\mu$ m diam., cylindrical, hyaline, dextrinoid, thin-walled. *Lamellar trama* regular to subregular; hyphae 3–10  $\mu$ m diam., cylindrical, hyaline, inamyloid, thin-walled. *Stipe tissue* monomitic, parallel, tightly packed; *stipitipellis* composed of repent cortical hyphae and terminal hairs; *cortical hyphae* 3–5  $\mu$ m diam., cylindrical, slightly thick-walled, dextrinoid, violet in water, bluish

grey in KOH; *medullary hyphae* 2–5  $\mu$ m diam., cylindrical, thin-walled, inamyloid to slightly dextrinoid, hyaline to slightly violet in water, hyaline in KOH; *terminal hairs* 52–425  $\times$  5–10  $\mu$ m, similar to pileipellis hairs, cylindrical, thick-walled, secondary septa abundant, dextrinoid, violet in water, becoming midnight blue in KOH. *Clamp connections* present.

*Habitat*: Scattered on decomposing leaves and a few on twigs, in secondary forest with *Quercus* and *Dipterocarpus* species.

*Known Distribution*: Indonesia and Malaysia.

*Material examined*: INDONESIA, Java, West of Bogor, Hutan Penelitian, Haurbentes S06°32.646', E106°26.211', elev. 292 m, 14 January 2005, Kerekes 107 (BO, SFSU). MALAYSIA, Selangor, Selayang, Kanching Forest Reserve N03°17.954', E101°37.153', elev. 50–150 m, 8 June 2005, J.F Kerekes 83 (KLU-M, SFSU); same location, 8 June 2005, Kerekes 84 (KLU-M, SFSU).

*Notes*: *Crinipellis brunneipurpurea* was first described from Singapore by Corner (1996) and is characterized by a brownish purple pileus with concolorous stipe, free gills that stain purple with age and large spores (10–14  $\times$  3–5  $\mu$ m). The type was unavailable for examination, but the Indonesian and Malaysian collections match very well Corner's protologue, except for smaller basidiomes in the populations we examined. Corner did not mention a midnight blue reaction of the pileus and stipe hairs in

KOH, which easily distinguishes this species from other purplish coloured species, such as *C. tabtim* and *C. iopus*. *Crinipellis corvina* Har. Takah. differs from *C. brunneipurpurea* by the presence of whitish rhizomorphs, smaller basidiospores ( $6.5\text{--}8 \times 3.5\text{--}4.5$ ), abruptly adnexed gills, and growth on bark of *Torreya nucifera* Siebold & Zucc. (Takahashi, 2000).

4. *Crinipellis brunnescens* Kerekes, Desjardin & Retn. **sp. nov.**

(Figs 5: 1–6, 19)

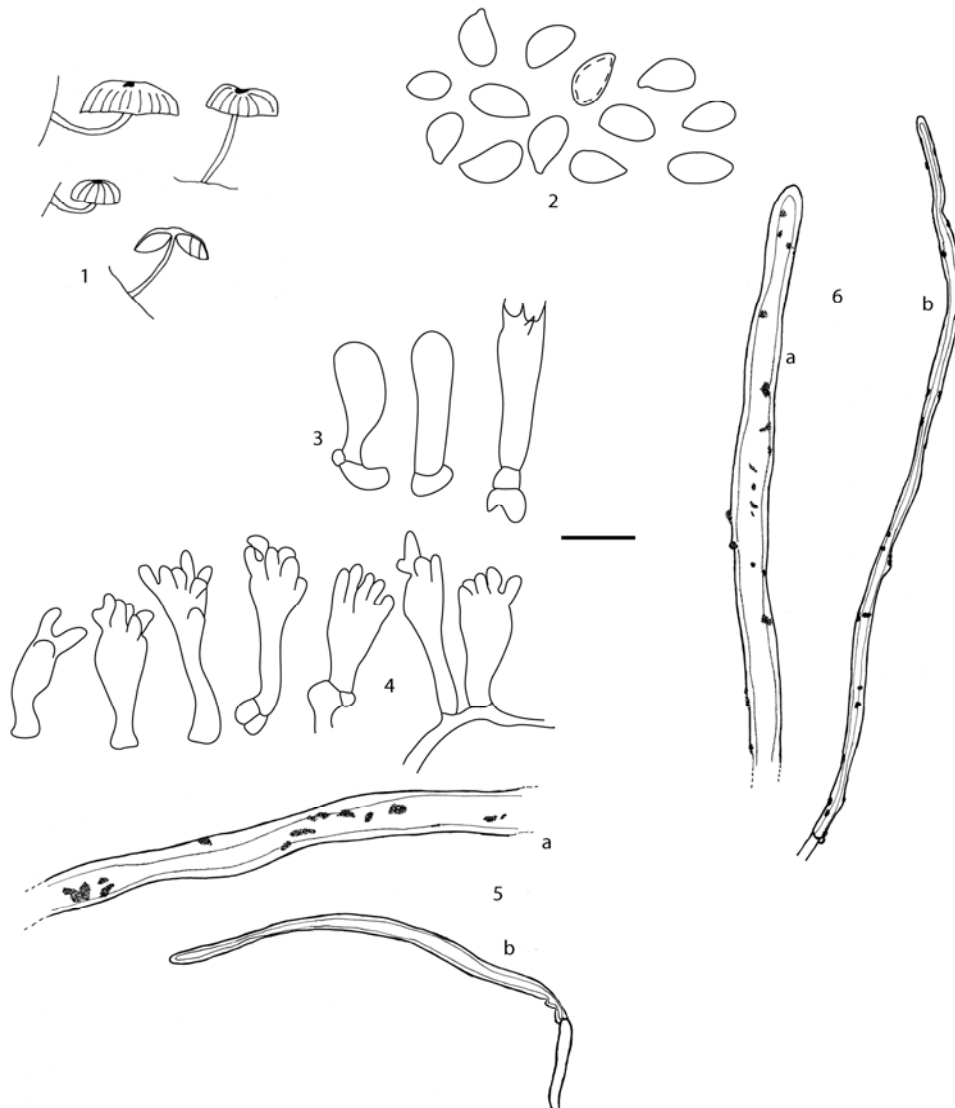
MycoBank: 512271

*Etymology*: *brunnescens* (Latin) = turning brown; referring to the brown staining and bruising of the lamellae.

*Pileus* 7–15 mm latus, convexus vel late convexus, atrobrunneus. *Lamellae* adnexae, albae, contusae brunnescentes. *Stipes* 8–12  $\times$  0.4–0.8 mm, cylindricus, furfuraceus vel tomentosus, atrobrunneus. Odor saporque nulli. *Basidiosporae* 6–10  $\times$  4–5  $\mu\text{m}$ ,

ellipsoideae, hyalinae. *Basidia* 15–25  $\times$  4–6  $\mu\text{m}$ , clavata, hyalinae, tetraspora. *Pleurocystidia* nulla. *Cheilocystidia* 12–25  $\times$  4–8  $\mu\text{m}$ , clavata, 2–8 apice surculis. *Trama lamellarum* regularis. *Caulocystidia* 75–327  $\times$  5–6  $\mu\text{m}$ , cylindraceutis. *Holotypus*: INDONESIA, Java, Mt. Halimun National Park, loop trail from Cikiniki, elev. ca 1000 m, 14 January 1998, D.E. Desjardin 6791 (BO).

*Pileus* 7–15 mm diam., convex to broadly convex, disc with or without a small, flattened papilla, or a small central depression surrounded by a raised ring, margin striate; surface dull, dry, radially fibrillose; disc dark brown (7–8F6–8), margin brown (7E7–8) with darker striae. *Context* thin, white. *Lamellae* horizontal, adnexed, subdistant with 2 series of lamellulae, convex, broad, white, staining dark brown to black where bruised and in age. *Stipe* 8–12  $\times$  0.4–0.8 mm, central, terete, cylindrical,  $\pm$  equal, curved, tough, pliant, furfuraceous to tomentose, insititious; dark brown (7–8F6–8)



**Fig. 5.** *Crinipellis brunnescens* (DED 6791). – 1. Basidiomes (x1). – 2. Basidiospores. – 3. Basidia and basidioles. – 4. Cheilocystidia. – 5. Caulocystidia. – 6. Pileipellis hairs. – Bar: 2–4, 5a, 6a = 10  $\mu\text{m}$ ; 5b, 6b = 25  $\mu\text{m}$ .

overall. *Rhizomorphs* absent. *Odor and taste* none.

*Basidiospores*  $6\text{--}10 \times 4\text{--}5 \mu\text{m}$  [ $x_m = 8.4 \pm 0.9 \times 4.8 \pm 0.4 \mu\text{m}$ ,  $Q = 1.5\text{--}2.3$ ,  $Q_m = 1.7 \pm 0.2$ ,  $n = 25$  spores per 1 collection], ellipsoid, amygdaliform in side view, smooth, hyaline, inamyloid, thin- to thick-walled. *Basidia*  $15\text{--}25 \times 4\text{--}6 \mu\text{m}$ , clavate, 4-spored. *Basidioles* clavate. *Pleurocystidia* none. Lamellar edge sterile. *Cheilocystidia* common; main body  $12\text{--}25 \times 4\text{--}8 \mu\text{m}$ , clavate, hyaline, inamyloid, thin-walled; apical appendages knob-like, 2–8 per cell, 1–6  $\mu\text{m}$  long, hyaline, inamyloid, thin-walled. *Pileipellis* a cutis, giving rise to terminal hairs with basal clamp connections. *Hairs*  $87\text{--}340 \times 4\text{--}5 \mu\text{m}$ , cylindrical, most with acute to blunt apex, lacking obvious secondary septations, thick-walled, inamyloid to slightly dextrinoid with dextrinoid incrustations, light tan-brown in water, becoming light brown to green in KOH, in KOH incrustations not as obvious. *Pileus trama* regular to subregular; hyphae  $3\text{--}5 \mu\text{m}$  diam., hyaline, inamyloid, thin-walled. *Lamellar trama* subregular to irregular; hyphae  $1.5\text{--}4 \mu\text{m}$  diam., hyaline, inamyloid, thin-walled. *Stipe tissue* monomitic, parallel, tightly packed; *stipitipellis* composed of repent cortical hyphae and terminal hairs; *cortical hyphae*  $3\text{--}5 \mu\text{m}$  diam., cylindrical, slightly thick-walled, slightly dextrinoid, light tan-brown in water, tan-brown to green in KOH; *medullary hyphae*  $2\text{--}5 \mu\text{m}$  diam., cylindrical, parallel, tightly packed, hyaline, strongly dextrinoid, thin-walled; *terminal hairs*  $75\text{--}327 \times 5\text{--}6 \mu\text{m}$ , cylindrical, thick-walled, inamyloid to slightly dextrinoid, with dextrinoid incrustations, light tan-brown in water and KOH. *Clamp connections* present.

*Habitat*: Solitary on undetermined hardwood sticks under *Castanopsis* sp. in montane primary forest.

*Known distribution*: Indonesia.

*Material examined*: INDONESIA, Java, Mt. Halimun National Park, loop trail from Cikiniki, elev. ca 1000 m, 14 January 1998, D.E. Desjardin 6791 (**Holotype**: BO; **Isotype**: SFSU).

*Notes*: This species is characterized by dark brown to black staining of the broad lamellae when bruised and with age, a short stipe, and dextrinoid incrustations on the pileus hairs. *Crinipellis brunnescens* is somewhat similar to *C. herrerae* Singer (1976) described

from Mexico, but the latter differs in forming a deep rusty brown pileus, lamellae that do not stain brown, a pallid stipe, and pileus hairs that lack incrustations and do not turn green in KOH. The numerous apical appendages on the cheilocystidia of *C. brunnescens* differentiate this species from *C. mirabilis* (no. 14 below). Microscopically, *C. stupparia* (Berk. & M.A. Curtis) Pat., from the New World tropics resembles *C. brunnescens*, however *C. stupparia* forms a light brown pileus under 5 mm diam., a much longer stipe (up to 25 mm), and the lamellae do not stain brown (Singer, 1943).

**5. *Crinipellis carecomoeis* var. *litseae*** Singer, Lilloa 8: 489. 1943. (Fig. 6: 1–2)

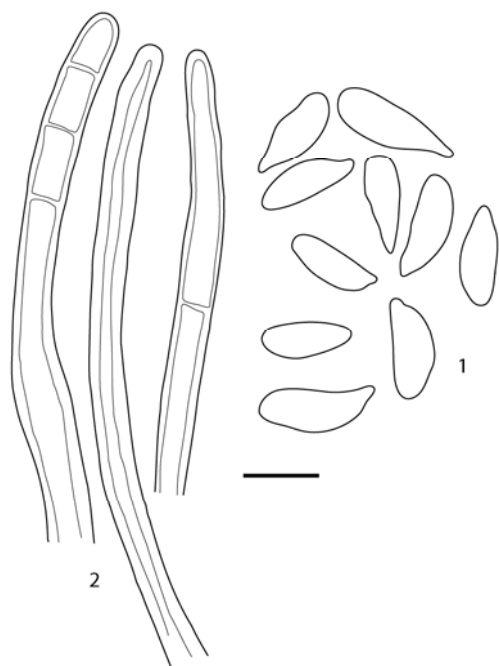
*Type*: Philippines, Laguna, Mt. Makiling, 5 Sept. 1917, coll. by N. Catalan, det. by Patouillard as *Crinipellis stipitaria*, on dead twigs of *Litsea perrottetii* (**Holotype**: FH!).

#### ***Macromorphological description adapted from protologue***

*Pileus* 3–4 mm diam. in dried condition, mostly campanulate with a more or less prominent papilla, becoming convex to plano-convex in age with either a flat disk, an umbilicus or more frequently with a small papilla, hairy all over; cinnamon buff to tawny olive in dried condition. *Lamellae* narrowly adnexed or free, close, rather broad, probably white when fresh. *Stipe*  $7\text{--}21 \times 0.2\text{--}0.5$  mm when dried, equal, more or less hirsute and somewhat grooved below, concolorous with the pileus. No mention of rhizomorphs, odor or taste.

#### ***Micromorphological description based on analysis of the holotype specimen***

*Basidiospores*  $12.8\text{--}16.5 \times 4.5\text{--}5.8 \mu\text{m}$  [ $x_m = 13.5 \pm 1.5 \times 5.1 \pm 0.5 \mu\text{m}$ ,  $Q = 2.4\text{--}2.9$ ,  $Q_m = 2.7 \pm 0.5$ ;  $n = 11$  spores per 1 collection], subfusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* subfusoid. *Pleurocystidia* absent. Lamellar edge badly colonised with a deuteromycete; fertile; no cheilocystidia observed. The cystidia described by Singer (1943) as “most commonly with conidia-like appendices which are confined to the very top or the upper half of the cheilocystidium and are subglobose with



**Fig. 6.** *Crinipellis carecomoeis* var. *litseae* (Holotype). – 1. Basidiospores. – 2. Pileipellis hairs. – Bar: 1-2 = 10  $\mu\text{m}$ .

attenuate connection with the main body” are undoubtedly chains of conidia from the deuteromycete colonisation. *Pileipellis* a cutis giving rise to thick-walled hairs. *Hairs* immeasurable in length ( $> 200 \mu\text{m}$ )  $\times$  3.5–6.5  $\mu\text{m}$ , evenly cylindrical, not appreciably attenuated towards the apex, walls smooth, yellowish to yellowish brown, inamyloid to dextrinoid; thick-walled 1.5–2.5  $\mu\text{m}$ , apex of hairs with or without ladder-like secondary septations; base of hairs sometimes with dark brown plaque-like incrustations.

**Habitat:** On dead twigs of *Litsea perrottetii*.

**Known distribution:** Philippine Islands.

**Material examined:** PHILIPPINES, Laguna, Mt. Makiling, 5 September 1917, coll. by N. Catalan, det. by Patouillard as *Crinipellis stipitaria*, on dead twigs of *Litsea perrottetii* (**Holotype:** FH).

**Notes:** This taxon is apparently known only from the holotype specimen. It is tentatively accepted here as representing a distinct species of *Crinipellis* and we have no comment on whether it represents a variety of *C. carecomoeis* (described originally from Cuba) or a synonym of another taxon. *Crinipellis carecomoeis* var. *subelata* Singer (1943), described from material collected in New Caledonia, is accepted as an insufficiently

known taxon in this monograph (see no. 22 below).

**6. *Crinipellis cervino-alba*** Corner, Beih. Nova Hedwigia 111: 119. 1996.

**Type:** Malaysia, Johore, Mawai, Corner s.n. 28 September 1934 (herb. Corner, E).

**Description adapted from the protologue:**

**Pileus** 3–6.5 mm diam., convex to nearly plane, with a minute acute umbo, appressed-fibrillose to felted in radial ridges, fawn buff with a fuscous disc. **Context** thin, pale brown. **Lamellae** free, subdistant (12–14) with 2–3 series of lamellulae, narrow, white. **Stipe** 4–7  $\times$  0.3–0.5 mm, slightly thickened at base, appressed fibrillose-felted, pale fuscous fawn. **Rhizomorphs** absent. **Odor and taste** none.

**Basidiospores** 9–11  $\times$  4.5–5.5  $\mu\text{m}$ , fusiform, smooth, hyaline. **Basidioles** sub-acerose. **Pleurocystidia** absent. Lamellar edge sterile. **Cheilocystidia** with main body  $\sim 20 \times 5\text{--}7 \mu\text{m}$ , irregularly clavate, verrucose with obtuse warts 1–3  $\times$  1.0  $\mu\text{m}$ . **Pileipellis** hairs 3–6  $\mu\text{m}$  diam., cylindrical and tapering to a subacute apex 2  $\mu\text{m}$  diam., smooth (not incrusted), thick-walled, brown.

**Habitat:** On dead wood in swamp forest.

**Known distribution:** Malaysia.

**Material examined:** Type was not available for study.

**Notes:** Corner noted how this species is similar to *C. herrerae* Singer, described from Mexico (Singer, 1976), although *C. cervino-alba* is lighter in color, has a shorter stipe and has cheilocystidia with shorter apical appendages. This species has an unusual habitat in swamp forests and was not recollected during our field studies.

**7. *Crinipellis cupreostipes*** Kerekes, Desjardin & Lumyong **sp. nov.**

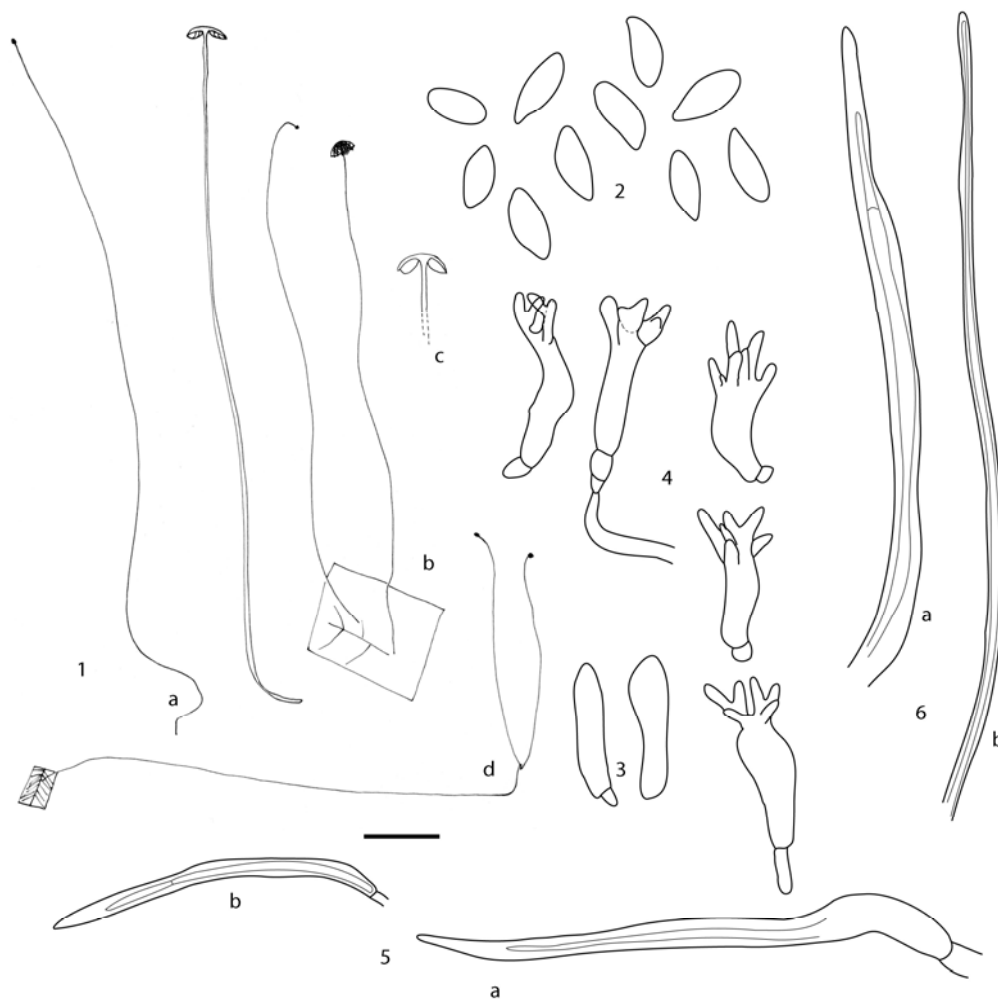
(Figs 7: 1–6, 19)

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**Etymology:** *cupreus* (Latin) – copper-colored; *stipes* (Latin) -stipe; referring to the copper colored stipe.

**Pileus** 1–9 mm latus, hemisphaericus deinconvexus, brunneus. **Lamellae** adnexae. **Stipes** 40–550  $\times$  0.5–1 mm, cylindricus, pubescentes, cupreus. **Odor** saporque nulli. **Basidiosporae** 9–11  $\times$  4–4.5  $\mu\text{m}$ , fusiformis, hyalinae. **Basidia** 19–20  $\times$  4–5  $\mu\text{m}$ , clavata, hyalinae, tetraspora. **Pleurocystidia** nulla. **Cheilocystidia** 14–17  $\times$  4–6  $\mu\text{m}$ , clavata, 1–7 apice surculis. **Trama lamellarum** regularis. **Caulocystidia** 72–160  $\times$  3–6  $\mu\text{m}$ ,





**Fig. 7.** *Crinipellis cupreostipes* (JFK 31). – 1. Basidiomes (JFK 31, 55, 131) (a. 0.5x. b. 0.5x. c. 2x. d. 0.5x). – 2. Basidiospores. – 3. Basidioles. – 4. Cheilocystidia. – 5. Caulocystidia. – 6. Pileipellis hairs. – Bar: 2-4 = 10  $\mu\text{m}$ ; 5a, 6a = 10  $\mu\text{m}$ ; 5b, 6b = 25  $\mu\text{m}$ .

cylindraceis. *Holotypus*: THAILAND, Chiang Mai Province, Doi Inthanon National Park, jct of Highway 1009 and road to Mae Chem, N18 31.58', E098 29.64', 1703 m, 27 June 2005, Kerekes 131 (CMU).

*Pileus* 1–9 mm diam., truncately hemispherical to convex, becoming plano-convex with a circular depression surrounding a central papilla, a few with a raised disc and concentric raised zones around papilla at maturity; many stipes topped with tiny, unopened primordial pilei, these convex to conical with inrolled margins and a distinct papilla; radially appressed-fibrillose; papilla black to dark brown; disc dark brown (6F7) becoming brown (6D7) to cream at margin with brown (6E7) fibrils, becoming paler overall with age. *Context* < 1 mm thick, cream to light brown (6D6), unchanging. *Lamellae* adnexed to free, subdistant to close with 2–3 series of lamellulae, white to cream. *Stipe* 40–550  $\times$  0.5–1 mm, central, cylindrical, wiry,

rhizomorphic stipes often terminating in primordial caps, few branching; with white to cream cobweb-like pubescence along stipe; white at extreme apex becoming brownish orange (6C7) to brown (6D7) and resembling copper wire. *Rhizomorphs* abundant and similar to stipes, resembling copper wire, most arise from decomposing leaf litter and stand erect, some terminating in primordial pilei. *Odor and taste* none.

*Basidiospores* 9–11  $\times$  4–4.5  $\mu\text{m}$  [ $x_m = 9.6 \pm 0.6 \times 4.0 \pm 0.1 \mu\text{m}$ ,  $Q = 2.2\text{--}2.8$ ,  $Q_m = 2.4 \pm 0.2$ ,  $n = 25$  spores per 1 collection], fusiform, smooth, hyaline, inamyloid, thin- to thick-walled. *Basidia* 19–20  $\times$  4–5  $\mu\text{m}$ , clavate, 4-spored. *Basidioles* clavate to cylindrical with rounded to subacute apex. *Pleurocystidia* absent. *Cheilocystidia* common; main body 14–17  $\times$  4–6  $\mu\text{m}$ , clavate, hyaline, inamyloid, thin-walled; apical appendages 1–7  $\mu\text{m}$  long,

cylindrical or finger-like, hyaline, inamyloid, thin walled. *Pileipellis* a cutis of hyaline, slightly dextrinoid hyphae giving rise to terminal hairs with basal clamp connections. *Hairs* 260–520 × 4–5 µm diam., cylindrical, apices bluntly rounded or tapering, with secondary septations, thick-walled, slightly dextrinoid, tan to hyaline in water, light brown to tan in KOH. *Lamellar and pileus trama* regular; hyphae 2–7 µm diam., hyaline, inamyloid. *Stipe tissue* monomitic, parallel, tightly packed; *stipitipellis* composed of repent cortical hyphae and terminal hairs; *cortical hyphae* 4–6 µm diam., cylindrical, dextrinoid, copper yellow in water, yellowish tan in KOH; *medullary hyphae* 4–7 µm diam., cylindrical, inamyloid, hyaline in water, hyaline in KOH; *terminal hairs* 72–160 × 3–6 µm, cylindrical, thick-walled (1–2 µm), dextrinoid, hyaline to brownish yellow in water and KOH, similar to hairs in pileipellis but more with an acute and tapering apex and less secondary septa. *Clamp connections* present.

*Habitat*: Gregarious on decomposing dicot leaves and small twigs, in montane primary cloud forest containing *Quercus*, *Magnolia*, and *Ficus* species.

*Known distribution*: Thailand.

*Material examined*: THAILAND. Chiang Mai Province, Doi Inthanon National Park, jct of Highway 1009 and road to Mae Chem, N18 31.58', E098 29.64', 1703 m, 25 June 2004, Kerekes 31 (CMU, SFSU); same location, 3 July 2004, Kerekes 55 (CMU, SFSU); same location, 27 June 2005, Kerekes 131 (**Holotype**: CMU; **Isotype**: SFSU).

*Notes*: The most distinctive and diagnostic feature of this new species is the very long copper coloured stipes (up to 550 mm), and abundant copper coloured rhizomorphs, many of which terminate in primordial pilei. These are unique characters within the genus *Crinipellis*. *Crinipellis elata* Pat., accepted here as an insufficiently known taxon, was described as having a long stipe (up to 170 mm), but the stipe is greyish brown not copper colored, and unfortunately the holotype specimen is represented by immature, sterile basidiomes (see no. 27 below).

8. *Crinipellis dipterocarpi* Singer, Lilloa 8: 496. 1943. (Fig. 8: 1–5, 19)

*Type*: VIETMAN (TONKIN), Eberhardt LBA #6 det. by Patouillard as *Crinipellis*

*stipitarius*, on leaves and fruits of *Dipterocarpus costatus* (**Holotype**: F!).

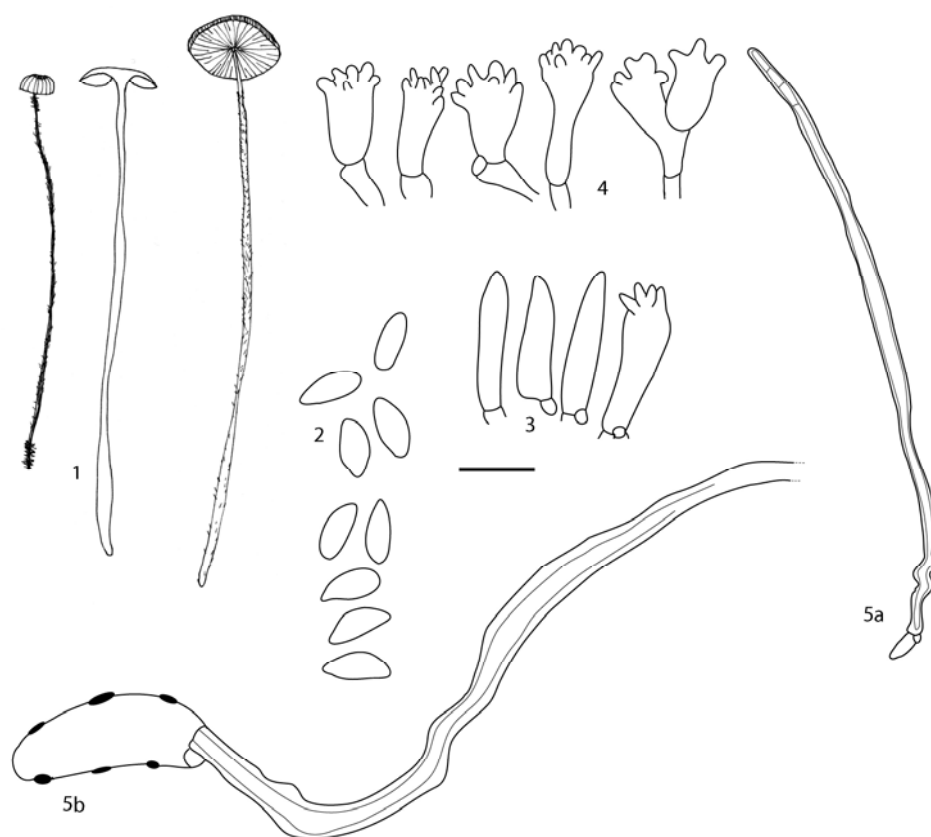
#### *Analysis of the holotype specimen*

The holotype specimen consists of five pilei and eight stipes (two as intact basidiomes) loose in the packet or with stipe attached to dipterocarp leaf fragments. As dried: *Pileus* 3–4 mm diam., convex-umbilicate, hirsute, evenly brown around a darker umbilicus. *Lamellae* close, broad, brown with white crystalline edges. *Stipe* up to 15 × 0.5 mm, pale greyish brown, pubescent, arising from the substrate, lacking obvious rhizomorphs.

*Basidiospores* (7–)7.5–10 × 3.2–3.8 µm [ $x_m = 8.3 \pm 1.0 \times 3.5 \pm 0.2 \mu\text{m}$ ,  $Q = 2.1\text{--}2.6$ ,  $Q_m = 2.4 \pm 0.2$ ,  $n = 10$  spores per 1 collection], elongate-ellipsoid to subfusoid, smooth, hyaline, inamyloid, thin-walled or a few thick-walled. *Basidia* clavate, 4-spored, clamped. *Basidioles* subfusoid to fusoid. *Pleurocystidia* absent. *Cheilocystidia* common, lamellar edge sterile; main body 8–16 × 3.2–8 µm, subcylindrical to clavate, with 4–8 apical appendages; apical appendages 1.5–6.5 × 1–1.8 µm finger-like, thick-walled, hyaline, inamyloid. *Pileipellis* of thick-walled hairs. *Hairs* immeasurable in length, > 300 × 2–3.2 µm, cylindrical and often sinuous below but gradually tapering to an acute apex, hyaline to yellow or ochraceous, inamyloid to dextrinoid (with dextrinoid contents), with scattered secondary septation; walls up to 1 µm thick, smooth, non-incrusted; subtending hyphae non-incrusted, thinner-walled, inamyloid.

#### *Description based on fresh material*

*Pileus* 1–10 mm diam., hemispherical to convex with inrolled margins and no obvious papilla, becoming convex to plano-convex in age with a shallow umbilicus, no ridges or furrows of concentric circles around disc, hirsute to radially appressed-fibrillose with hairs often hanging over the margin; disc and hairs light brown (6D6) to dark brown (6–7F7), with age margin becoming pale greyish orange (5B3–4) to cream. *Context* < 1 mm thick, white. *Lamellae* adnate to shallowly adnexed, subdistant to close with 1–3 series of lamellulae, white. *Stipe* 11–50 × <1 mm, central, terete, cylindrical, equal, tough, longitudinally striate, twisted, insititious, hirsute overall,



**Fig. 8.** *Crinipellis dipterocarpi* (JFK 130). – 1. Basidiomes (JFK 136) (x2). – 2. Basidiospores. – 3. Basidia and basidioles. – 4. Cheilocystidia. – 5a-b. Pileipellis hair. – Bar: 2-4, 5b = 10 µm; 5a = 50 µm.

ornamentation dense at base; extreme apex white to cream, brown (6E7) to dark brown (6F8) below. *Rhizomorphs* very thin, uncommon, arising from decomposing leaf litter, reddish brown to black, not present in all collections. *Odor and taste* none.

*Basidiospores* 5–10 × 3–5.5 µm [ $x_{mr} = 8.0\text{--}8.8 \times 3.8\text{--}4.1$  µm,  $x_{mm} = 8.6 \pm 0.7 \times 4.0 \pm 0.1$  µm,  $Q = 1.3\text{--}3.0$ ,  $Q_{mr} = 2.0\text{--}2.3$ ,  $Q_{mm} = 2.2 \pm 0.1$ ;  $n = 10\text{--}25$  spores per 9 collections], elongate-ellipsoid to subfusoid, smooth, hyaline, inamyloid, thin-walled or a few thick-walled. *Basidia* 18–22 × 5–6 µm, clavate, 4-spored. *Basidioles* clavate to subfusoid or fusoid. *Pleurocystidia* absent. *Cheilocystidia* common, lamellar edge sterile; main body 8–19 × 3.2–10 µm, subcylindrical to broadly clavate, hyaline, inamyloid, thin-walled, with 4–9 apical appendages; apical appendages 1.5–6.5 × 1–1.8 µm, finger-like, hyaline, inamyloid, thick-walled. *Pileipellis* a cutis with large inflated cells, some with reddish brown and dextrinoid incrustations, giving rise to terminal hairs with basal clamp connections. *Hairs* 400–537 × 2–6 µm, cylindrical and often sinuous below but gradually tapering to an acute or

rounded apex, secondary septations scattered to abundant, thick-walled (up to 2 µm), inamyloid to dextrinoid, light brown to tan with some incrustations in water, hyaline to yellow or ochraceous in KOH. *Lamellar and pileus trama* regular; hyphae 3–5 µm diam., cylindrical, smooth, hyaline, inamyloid, thin-walled. *Stipe tissue* monomitic, parallel, tightly packed; *stipitipellis* composed of repent cortical hyphae and terminal hairs and caulocystidia; *cortical hyphae* 3–5 µm diam., cylindrical, greenish brown in KOH; *medullary hyphae* up to 5 µm diam., cylindrical, hyaline in KOH; *caulocystidia* 25–40 × 5–6 µm, cylindrical; *terminal hairs* 85–300 × 6–8 µm, thick-walled (2–3 µm), inamyloid to dextrinoid, hyaline to brown in KOH, similar to hairs in pileipellis but more with an acute apex and less secondary septa. *Clamp connections* present.

*Habitat*: Scattered to gregarious on leaves and small sticks of undetermined dicot trees in montane primary forests with *Pinus*, *Castanopsis* and Dipterocarpaceae species, and in secondary forests with *Dipterocarpus obtusifolius* Teijsm. ex Miq. and *Pinus kesiya* Royle ex Gordon.

*Known Distribution:* Indonesia, Malaysia, Thailand, and Vietnam.

*Material examined:* INDONESIA. Borneo, East Kalimantan, Kayan Mentarang National Park, 5 April 2003, A. Retnowati 410 (same as ZT 12031) (SFSU). MALAYSIA. Pahang, Fraser's Hill, Bishop trail, 26 September 2003, TYS 111 (KLU-M, SFSU). THAILAND. Chiang Mai Province, Huai Nam Dang National Park, Hwy 1095, 24 June 2003, D. E. Desjardin 7570 (SFSU); Chiang Mai Province, 22 km marker on Hwy 1095 on road to Mae Hong Son, elev. ca 725 m, 2 July 2003, D. E. Desjardin 7602 (SFSU); Chiang Mai Province, Doi Inthanon National Park, Hwy 1009 at 25 km marker, N18°32.56', E98°33.51', elev. 1075 m, 6 June 2005, Kerekes 130 (CMU, SFSU); Chiang Mai Province, Doi Inthanon National Park, jct of Highway 1009 and road to Mae Chem, N18°31.58', E98°29.64', elev 1700 m, 25 June 2004, Kerekes 33 (CMU, SFSU); same location, 3 July 2004, Kerekes nos. 51, 52, 53, 54 (CMU, SFSU); same location, 27 June 2005, Kerekes nos. 130, 132 (CMU, SFSU); Chiang Mai Province, Mae Sae Village near 50 km marker on Hwy 1095, N19°14.599', E98°38.456', elev. 962 m, 26 June 2005, Kerekes 126 (CMU, SFSU); same location, 26 June 2005, Kerekes 127 (CMU, SFSU); same location, 3 July 2005, Kerekes 136 (SFSU). VIETNAM (TONKIN). Eberhardt LBA #6, det. by Patouillard as *Crinipellis stipitarius*, on leaves and fruits of *Dipterocarpus costatus* (**Holotype:** FH).

*Notes:* Our collections of *C. dipterocarpi* generally have longer stipes than reported in the protologue by Singer, and the cheilocystidia measured in our type study and from recently collected material were shorter than those reported in the protologue, 8–19  $\mu\text{m}$  versus 15–27  $\mu\text{m}$  (respectively). There was also no report in the protologue of incrustations on the pileipellis cells or terminal hairs. The incrustations are apparent in the recent collections, especially when mounted in water or Melzer's reagent (where they are dextrinoid). Our recent collections were collected at high elevations in forests with Dipterocarpaceae; unfortunately, the leaves and substrate were not always identifiable. Singer (1976) reported *C. dipterocarpi* to be close to *C. foliicola* Singer (from Florida and Venezuela), *C. phyllophila* Singer (from Mexico), and *C. piceae* Singer (from temperate Asia and North America). In addition to disparate geographic location, habitat and substrate, *C. dipterocarpi* can be distinguished from all of these species in cheilocystidia and pileus hair morphologies. For a detailed comparison, refer to Singer (1976: 31).

**9. *Crinipellis dipterocarpi* f. *cinnamomea***  
Kerekes, Desjardin & Lumyong, **forma nov.**  
(Figs 9: 1–6, 19)

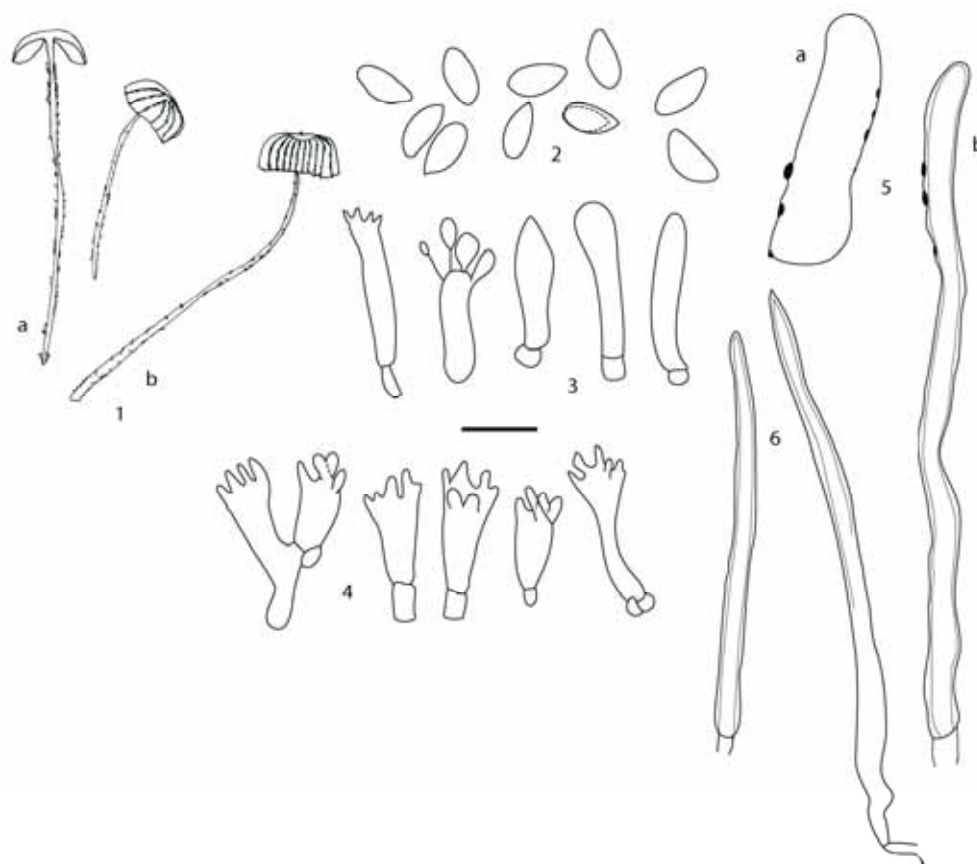
MycoBank: 512273

*Etymology:* *cinnamomeus* (Latin) – referring to the cinnamon brown coloured pileus and stipe.

*Pileus* 2–7 mm latus, hemisphaericus, cinnamomeus. *Lamellae* liber ad adnexae. *Stipes* 15–45  $\times$  < 1 mm, cylindricus, fibrillosus, rubrobrunneus. Odor saporque nulli. *Basidiosporae* 6–11  $\times$  3–5  $\mu\text{m}$ , ellipsoideae, hyalinae. *Basidia* 15–21  $\times$  4–5  $\mu\text{m}$ , clavata, hyalinae, tetraspora. *Pleurocystidia* nulla. *Cheilocystidia* 9–20  $\times$  5–7  $\mu\text{m}$ , clavata, 1–10 apice surculis. *Caulocystidia* 67–150  $\times$  5–7.5  $\mu\text{m}$ , cylindraceis. *Holotypus:* THAILAND. Chiang Mai Province, Doi Inthanon National Park, jct of Highway 1009 and road to Mae Chem, N18°31.58', E98°29.64', elev. 1703 m, 3 July 2004, Kerekes 50 (CMU).

*Pileus* 2–7 mm diam., when young truncately hemispherical and papillate to hemispherical-subumbilicate with a central papilla, margin incurved, in age becoming convex, subumbilicate with a less obvious papilla, radially appressed-fibrillose with hairs hanging over edge of margin; reddish brown (8E–F7) to cinnamon-coloured gradually becoming light brown (6D6) near the margin, in age margin becoming cream beneath the hairs. *Context* < 1 mm thick, white, unchanging. *Lamellae* free to adnate, subdistant to close with 2 series of lamellulae, white. *Stipe* 15–45  $\times$  < 1 mm, central, cylindrical,  $\pm$  equal, tough, insititious, fibrillose to squamulose overall, ornamentation denser when young and near the base, with longitudinal furrows; reddish brown (8E7), becoming cream with reddish brown hairs but often appearing light brown (6D6–7) overall. *Rhizomorphae* not present in all collections, if present, hair-like, short (5–30 mm), reddish brown (8F7) to brown (7E6), on decomposing debris; no fruiting bodies arising from the rhizomorphae. *Odor and taste* none.

*Basidiospores* 6–11  $\times$  3–5  $\mu\text{m}$  [ $x_{\text{mr}}$  = 8.5–9.3  $\times$  3.8–4.0  $\mu\text{m}$ ,  $x_{\text{mm}}$  = 8.8  $\pm$  0.3  $\times$  4.0  $\pm$  0.1  $\mu\text{m}$ ,  $Q$  = 1.4–3.0,  $Q_{\text{mr}}$  = 2.2–2.3,  $Q_{\text{mm}}$  = 2.2  $\pm$  0.1;  $n$  = 20–25 spores per 6 collections], ellipsoid to oblong or subcylindrical, smooth, hyaline, inamyloid, thin-walled. *Basidia* 15–21  $\times$  4–5  $\mu\text{m}$ , clavate, 4-spored. *Basidioles* clavate to cylindrical with rounded to subacute apex. *Pleurocystidia* absent. *Cheilocystidia* crowded along gill edge; main body 9–20  $\times$  5–7  $\mu\text{m}$ ,



**Fig. 9.** *Crinipellis dipterocarpi* f. *cinnamomea* (JFK 32). – 1. Basidiomes (JFK 32, 104) (x2). – 2. Basidiospores. – 3. Basidia and basidioles. – 4. Cheilocystidia. – 5a. Pileipellis cell. 5b. Pileipellis hair. 6. Caulocystidia. – Bar: 2-5a = 10  $\mu\text{m}$ ; 5b, 6 = 25  $\mu\text{m}$ .

clavate to broadly clavate, hyaline, inamyloid, thin-walled to slightly thick-walled, with 1–10 apical appendages; apical appendages 2–6  $\mu\text{m}$  long, finger-like, hyaline, inamyloid, thin walled. *Pileipellis* a cutis of inflated cells, 6–11  $\mu\text{m}$  diam., hyaline, with peg-shaped to irregular, reddish brown incrustations, dextrinoid, hyaline to tan in KOH, giving rise to terminal hairs with basal clamp connections. *Hairs* 62–475  $\times$  4–5  $\mu\text{m}$ , cylindrical, apices rounded to acute, few with blunt apex, with widespread secondary septations, thick-walled (1.5–3.5  $\mu\text{m}$ ), dextrinoid, golden brown to yellowish brown in KOH, with reddish brown incrustations in water and Melzer's reagent (few). *Pileus trama* regular; hyphae 3–7  $\mu\text{m}$  diam., hyaline, inamyloid. *Lamellar trama* regular; hyphae 3–5  $\mu\text{m}$  diam., hyaline, inamyloid. *Stipe tissue* monomitic, parallel, tightly packed; *stipitipellis* composed of repent cortical hyphae and terminal hairs; *cortical hyphae* 2–8  $\mu\text{m}$  diam., cylindrical, thick-walled, dextrinoid, light golden brown; *medullary hyphae* 2–6  $\mu\text{m}$  diam., cylindrical, hyaline,

thin-walled, strongly dextrinoid; *terminal hairs* 67–150  $\times$  5–7.5  $\mu\text{m}$ , cylindrical, thick-walled, with distant or absent secondary septations, dextrinoid, light brown to yellow brown in water and KOH. *Clamp connections* present.

**Habitat:** Scattered on decaying dicot leaves and twigs in primary montane cloud forest and in mixed forests with Magnoliaceae, *Castanopsis*, *Quercus*, and *Ficus* species.

**Known Distribution:** Indonesia, Malaysia, and Thailand.

**Material examined:** INDONESIA. Java, Cibodas Botanical Garden, trail to Mt. Gede, S06°44.675', E107°00.423', elev. 1406 m, 22 January 1999, A. Retnowati 151 (SFSU); same location, 13 January 2005, Kerekes 104 (BO, SFSU). MALAYSIA. Pahang Province, Fraser's Hill, Kindersley Trail, 9 September 2003, T. Shin 193, (SFSU); Pahang Province, Fraser's Hill, Bishop's trail, N03°42.949', E101°44.430', elev. 1212 m, 15 January 2004, Kerekes 17 (KLU-M, SFSU); Pahang Province, Fraser's Hill, Pine Tree Trail, N03°42.700', E101°43.650', elev. 1320–1140 m, 16 January 2004, Kerekes 20 (KLU-M, SFSU). THAILAND, Chiang Mai Province, Doi Inthanon National Park, jct of Highway 1009 and road to Mae Chem, N18°31.58', E98°29.64', elev. 1703 m, 25 June 2004, Kerekes 32 (CMU, SFSU); same location, 3 July

2004, Kerekes 50 (**Holotype**: CMU; **Isotype**: SFSU); same location, 27 June 2005, Kerekes 133 (CMU, SFSU).

**Notes:** *Crinipellis dipterocarpi* f. *cinnamomea* has a characteristic reddish brown to cinnamon coloured pileus and stipe. In addition to this distinct colouring, the incrustations on the pileipellis cells subtending the terminal hairs have a more distinct reddish brown colour and the spores are slightly longer than *C. dipterocarpi* f. *dipterocarpi*. Both forms were often collected in the same location. *Crinipellis dipterocarpi* f. *cinnamomea* is phenetically similar to *C. tabtim*, but the latter species has pileus hairs that turn grey to slate blue in KOH and have distinct burgundy coloured incrustations in water. *Crinipellis hepatica* also has a reddish brown (brown rufous) pileus and stipe, however, the cheilocystidia of this species lack apical appendages (Corner, 1996). There is 92% MP-BS, 82% ML-BS and 1.0 PP support for inclusion of *C. dipterocarpi* f. *cinnamomea* within the *C. dipterocarpi* f. *dipterocarpi* clade, and all four included f. *cinnamomea* sequences form an internal clade with 88% BS and 1.0 PP support (Fig. 1). Interestingly, DED 7570 a collection with purple pileus, is also included in the *C. dipterocarpi* clade suggesting that

there may be additional color forms within the species.

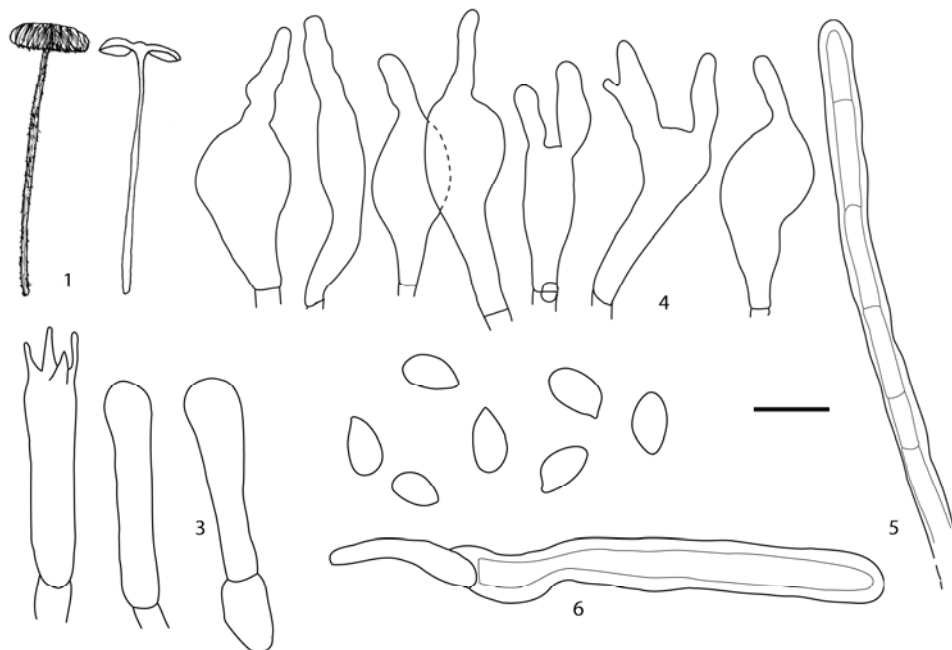
**10. *Crinipellis furcata* Kerekes, Desjardin & Lumyong sp. nov.** (Figs 10: 1–6, 19)

Mycobank: 512274

**Etymology:** *furcata* (Latin) – forked; referring to the forked cheilocystidia.

**Pileus** 6–11 mm latus, convexus vel late convexus, atrobrunneus. **Lamellae** liber ad adnexae. **Stipes** (15–) 30–40 × 1 mm, cylindricus, squamulosus, atrobrunneus. **Odor** saporque nulli. **Basidiosporae** 6.5–9 × 4–5 μm, ellipsoideae, hyalinae. **Basidia** 23–30 × 6–8 μm, clavata, hyalinae, tetraspora. **Pleurocystidia** nulla. **Cheilocystidia** (15–) 22–42 × 4–15 μm, clavata, bifurcates, 0–2 apice surculis. **Trama lamellarum** regularis. **Caulocystidia** -75 × 6–7 μm, cylindraces. **Holotypus:** INDONESIA. Bali, south ridge of Mt. Catur, east side of Lake Bratan, elev. 1200–1800 m, 17 January 1999, D. E. Desjardin 6951 (BO).

**Pileus** 6–11 mm diam., convex to plano-convex, umbilicate, papillate, disc scaly, margin radially-fibrillose, extreme margin with long hairs that form a complete fibrillose partial veil and remain as an appendiculate margin on expanded pilei; surface dull, dry; dark brown (7F6–8) to nearly black overall. **Context** < 1 mm thick, white to cream. **Lamellae** horizontal, free to adnexed, close to crowded with 2–3 series of lamellulae, narrow (up to 1.5 mm), white to cream, non-marginate.



**Fig. 10.** *Crinipellis furcata* (DED 6951). – 1. Basidiomes (x1). – 2. Basidiospores. – 3. Basidia and basidioles. – 4. Cheilocystidia. – 5. Pileipellis hair. – 6. Caulocystidia. – Bar: 2–6 = 10 μm.

*Stipe* (15–) 30–40 × 1 mm, central, cylindrical, terete, equal, tough, solid, insititious, dull, dry, squamulose and dark brown (7F6–8) overall. *Rhizomorphs* absent. *Odor and taste* none.

*Basidiospores* 6.5–9 × 4–5 μm [ $x_{mr} = 7.2\text{--}7.6 \times 4.3\text{--}5.0 \mu\text{m}$ ,  $x_{mm} = 7.4 \pm 0.3 \times 4.7 \pm 0.4 \mu\text{m}$ ,  $Q = 1.3\text{--}2.3$ ,  $Q_{mr} = 1.4\text{--}1.8$ ,  $Q_{mm} = 1.6 \pm 0.2$ ;  $n = 10\text{--}25$  spores per 3 collections], ellipsoid, smooth, hyaline, inamyloid, thin- to thick-walled. *Basidia* 23–30 × 6–8 μm, clavate, 4-spored, sterigmata 5–6 μm long. *Basidioles* clavate to cylindrical with rounded to subacute apex. *Pleurocystidia* absent. *Cheilocystidia* crowded along gill edge; main body (15–) 22–42 × 4–15 μm, clavate to lageniform or irregular, majority bifurcated, hyaline, thin-walled, inamyloid; apical appendages (2–) 15–28 × 2–4 μm, 0–2 per cell (rarely more than two), hyaline, inamyloid, thin-walled. *Pileipellis* a cutis of inflated cells 5–8 μm diam., hyaline to light brown, slightly dextrinoid, with granular or spiral incrustations, giving rise to terminal hairs with basal clamp connections. *Hairs* > 70 × 4–6 μm, cylindrical, apices rounded, with abundant, widely spaced secondary septations, dextrinoid, brown in water and KOH. *Lamellar and pileus trama* subregular; hyphae 3–9 μm diam., hyaline, inamyloid. *Stipe tissue* monomitic, parallel, tightly packed; *stipitipellis* composed of repent cortical hyphae and terminal hairs; *cortical hyphae* 3–5 μm diam., cylindrical, slightly thick-walled, dextrinoid, hyaline to yellowish brown in KOH; *medullary hyphae* 1–4 μm diam., cylindrical, strongly dextrinoid; *terminal hairs* < 75 × 6–7 μm, cylindrical, similar to pileipellis hairs, thick-walled, weakly dextrinoid, hyaline to yellow or brown in KOH. *Clamp connections* present.

*Habitat*: Solitary on woody debris in montane primary and secondary forests and botanical garden.

*Known Distribution*: Indonesia and Thailand.

*Material examined*: INDONESIA, Bali, south ridge of Mt. Catur, east side of Lake Bratan, elev. 1200–1800 m, 17 Jan 1999, D. E. Desjardin 6951 (**Holotype**: BO; **Isotype**: SFSU); Java, Cibodas Botanical Garden, trail to Mt. Gede, S06° 44.675', E107° 00.423', elev. 1406 m, 13 Jan 2005, Kerekes 103 (BO, SFSU). THAILAND, Chiang Mai Province, Huai Nam Dang National Park, N19°18.29', E98°35.88', elev. 1538 m, 28 June 2004, Kerekes 38 (CMU, SFSU).

*Notes*: *Crinipellis furcata* is distinctive because of the fibrillose to squamulose, dark brown to black pileus and stipe, the distinctly bifurcated cheilocystidia with long apical projections, and a negative reaction of pileus hairs or stipe tissue in KOH. This species is similar to *C. corvina* Har. Takah., described recently from Japan, but the latter species has a purplish black pileus, and consistently thick-walled cheilocystidia that rarely bifurcate (Takahashi, 2000). *Crinipellis mirabilis* differs from *C. furcata* by forming a reddish brown to violet brown pileus with hairs that turn green in KOH, and has simple cheilocystidia. *Crinipellis furcata* is also phenetically similar to *C. atrobrunnea* and *C. pseudostipitaria* subsp. *orientalis*, however, both of the latter species have larger basidiospores, and grow on grasses.

**11. *Crinipellis hepatica*** Corner, Beih. Nova Hedwigia 111: 119. 1996.

*Type*: SINGAPORE, Bukit Timah, Corner s.n., 27 March 1943 (herb. Corner, E; alc. form.)

#### *Description adapted from the protologue*

*Pileus* 7–9 mm diam., convex to plane, often acutely umbonate at first with umbo disappearing in age, faintly sulcate, opaque, villous in the center, hoary with decumbent white fibrils toward the margin, brown rufous or liver-rufous. *Context* thin, paler than pileus surface. *Lamellae* adnexed to sinuate, subventricose, scarcely crowded (14–17) with 3 series of lamellulae, pale flesh coloured becoming deeper pinkish ochraceous, paler towards the white edge. *Stipe* 7–10 × 0.7–1 mm, cylindrical, subpruinose at the apex to fibrillose-puberulous at the base; apex pallid becoming pinkish ochraceous to bright rufous near the base. *Odor and taste* none.

*Basidiospores* 9–11 × 4.5–5.5 μm, subcylindrical, smooth, hyaline. *Basidia* 4-spored. *Basidioles* subacrose. Gill edge sterile. *Cheilocystidia* with main body 25–45 × 8–11 μm, subventricose to subfusiform, obtuse to acute, without appendages. *Pileipellis* cells of repent hyphae with rufous brown incrustations, giving rise to terminal hairs. *Hairs* –500 × 5–8 μm, or longer, scarcely tapered to the obtuse or subcapitate apices, lacking secondary septations, thick-walled, hyaline to pale yellow.

*Habitat*: On dead sticks in the forest.

*Known distribution*: Singapore.

*Material examined*: Type was not available for study.

*Notes*: We have not examined the type specimen stored at E in alcohol-formalin solution, nor have we encountered the species in fresh condition; therefore our concept of the species is based entirely on the protologue. Corner indicated that *C. hepatica* was similar to *C. omotricha* (Berk.) D.A. Reid, first described from South Africa, but the latter species grows on decayed grasses and has a greyish to pinkish brown pileus (Pegler, 1986).

**12. *Crinipellis* aff. *iopus*** Singer, Rev. Mycol. (Paris) 4: 63. 1939. (Figs 11: 1–4, 19)

*Type*: Collected by Nevodovski in the Botanical Garden of Alma Ata, Kazakhstan, U.S.S.R., May 1937 (LE).

***Macromorphological description adapted from the protologue (Singer 1942), and from photographs of recently collected material***

*Pileus* 6–12 mm diam., convex-umbilicate, margin initially incurved, sulcate to the disc, bright lilac when young, becoming white with age with pale fulvous-brown striae. Context thin, white. *Lamellae* narrowly adnexed, distant with 2 series of lamellulae, white. *Stipe* 30–35 × 1 mm, cylindrical, equal, base scarcely thickened, insititious, pulverulent-velutinous; bright lilac when fresh, white at the apex and brownish grey downwards when dried. *Rhizomorphs* not mentioned. *Odor and taste* none.

***Micromorphological description based on fresh material***

*Basidiospores* 9–12 × 4–5 μm [ $x_{mr} = 10.2\text{--}11.1 \times 4.0\text{--}4.4 \mu\text{m}$ ,  $x_{mm} = 10.5 \pm 0.5 \times 4.3 \pm 0.2 \mu\text{m}$ ,  $Q = 2.0\text{--}3.0$ ,  $Q_{mr} = 2.3\text{--}2.4$ ,  $Q_{mm} = 2.5 \pm 0.1$ ;  $n = 25$  spores per 3 collections], ellipsoid to subcylindrical, smooth, hyaline, inamyloid, thin-walled. *Basidia* 25–32 × 5–7 μm, clavate, 4-spored, with sterigmata 3–5 μm long. *Basidioles* clavate to cylindrical. *Pleurocystidia* absent. Gill edge heteromorphous. *Cheilocystidia* common; main body 12–26 × 5–12 μm, clavate to broadly clavate, hyaline, inamyloid, thick-walled with 0–6 apical appendages; apical appendages 1–11 μm

long, hyaline, inamyloid, thin walled. *Pileipellis* a cutis with chains of inflated cells 25–68 × 9–11 μm, clamped, with distinct brown incrustations in water, incrustations hyaline in KOH, incrustations and inflated cells dextrinoid, giving rise to terminal hairs with basal clamp connections. *Hairs* few, 125–275 × 3–6.5 μm, cylindrical, apices generally tapering and rounded, lacking secondary septations, thick-walled, inamyloid to weakly dextrinoid, hyaline to light brown in water, hyaline in KOH. *Pileus trama* regular; hyphae 3–5 μm diam., hyaline, inamyloid, thin-walled. *Lamellar trama* regular; hyphae 3–6 μm diam., cylindrical, hyaline, inamyloid, thin-walled. *Stipe tissue* monomitic, parallel, tightly packed; *stipitipellis* composed of repent cortical hyphae and terminal hairs; *cortical and medullary hyphae* indistinguishable, 2–5 μm diam., cylindrical, hyaline to light brown, cortical hyphae strongly dextrinoid; *terminal hairs* similar to pileipellis hairs, 100–188 × 5–7.5 μm, thick-walled, inamyloid to weakly dextrinoid, hyaline to light brown in water and KOH. *Clamp connections* present.

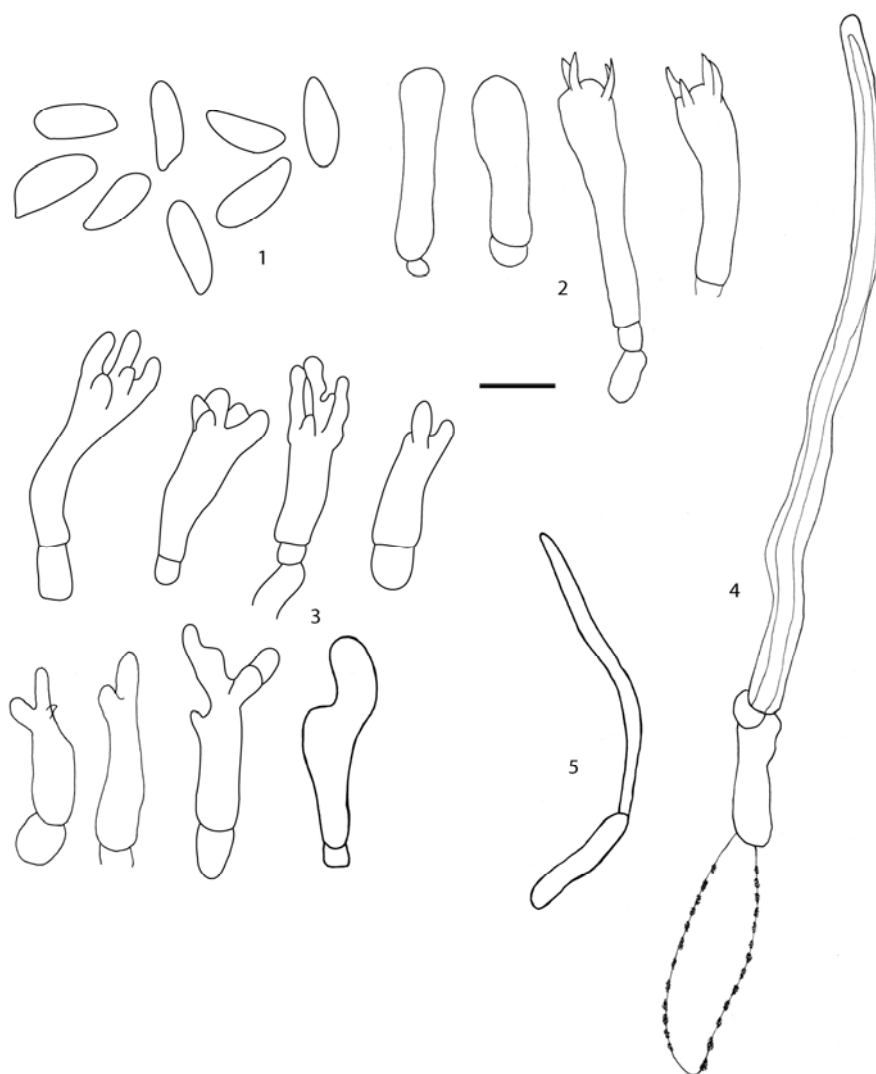
*Habitat*: On twigs in disturbed primary and secondary rainforests.

*Known distribution*: Botanical Garden of Alma Ata, Kazakhstan, and Papua New Guinea.

*Material examined*: PAPUA NEW GUINEA. Madang, Baitabag, Kau Wildlife Area, S5°09', E145°06', elev. ± 170 m, 2 February 1997, R. Walley 829 (GENT); Madang, Silibob, S5°12', E145°45', elev. ± 100 m, 29 January 1997, R. Walley 774 (GENT); Madang, Surinamvalley, Boroki Lake, S5°52', E145°51', elev. 600–750 m, A. Verbeken 97–312 (GENT); Madang, left of bridge, Binek River, S5°12', E145°45', elev. 100 m, 24 February 1997, A. Verbeken 97–404 (GENT).

*Notes*: We are tentatively identifying the Papua New Guinea specimens as representing *Crinipellis iopus*, described originally from a Botanical Garden in Kazakhstan (Singer, 1939, 1942). Whether the species is indigenous to Kazakhstan or was introduced into the botanical garden with plants from somewhere else is not known. Singer (1976) designated *C. iopus* the type species of the section *Iopodinae*, an infrageneric group established to accommodate brightly pigmented species (red, crimson, purple, lilac, violet) with pileus hairs that do not turn green or grey in KOH. Unfortunately, the protologue does not provide details regarding the cheilocystidia or the





**Fig. 11.** *Crinipellis* aff. *iopus* (RW 829). – 1. Basidiospores. – 2. Basidia and basidioles. – 3. Cheilocystidia (RW 829, AV 97-312). – 4-5. Pileipellis hairs. – Bar: 1-4 = 10  $\mu$ m; 5 = 25  $\mu$ m.

hyphae subtending the pileipellis hairs, both taxonomically important characters. Until further material of this intriguing species is located in Kazakhstan and compared with the Papua New Guinea material, our determination will remain tentative.

In the ML tree, *C. aff. iopus* was sister of *Moniliophthora* but with low statistical support, and its placement in the phylogenetic analyses made *Crinipellis* non-monophyletic. Interestingly, Singer (1976) included species currently accepted in *Moniliophthora* (e.g., *M. pernicioso*) in his sect. *Iopodinae* and our molecular data support this contention (Fig. 1). In *C. aff. iopus*, the chains of inflated, incrustated hyphae subtending the uncommon pileipellis hairs are very similar to the pileipellis anatomy of *Moniliophthora* species, as is the KOH reaction, and suggest transfer to *Moniliophthora* may be warranted. A positive outcome of such an

approach would be a monophyletic *Crinipellis* based on ITS data. Until further genes are sequenced, more taxa are added to the dataset, and the Papua New Guinea taxon is positively identified, formal transfer of *C. iopus* is not justified.

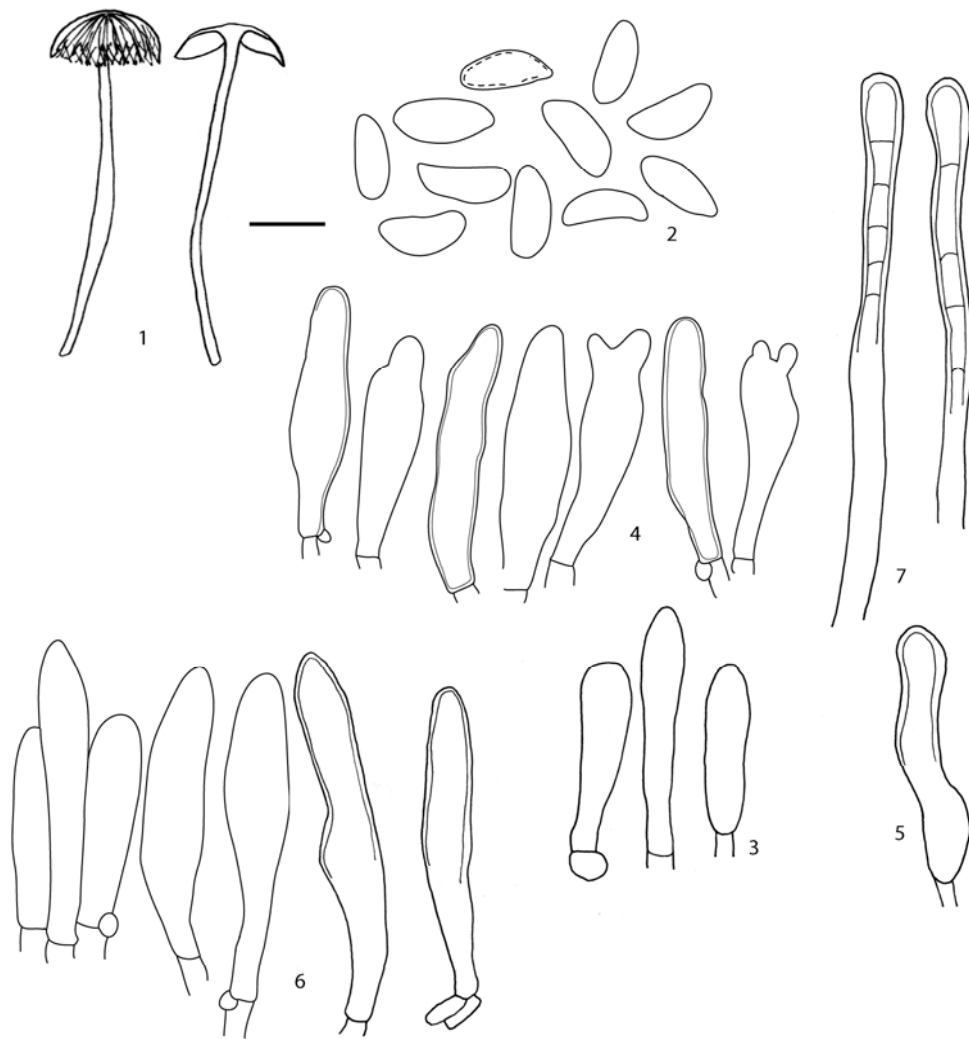
**13. *Crinipellis malesiana*** Kerekes, Desjardin and Vikineswary **sp. nov.**

(Figs 12: 1–7, 19)

Mycobank: 512275

*Etymology:* Malesia – the region including the Malay Peninsula and Indonesia; *malesiana* refers to the distribution of this species in Malesia.

*Pileus* 2–13 mm latus, convexus, brunneus. *Lamellae* adnexae. *Stipes* 4–22  $\times$  1–2 mm, cylindricus, fibrillosus, brunneus. Odor saporque nulli. *Basidiosporae* 8–12.5  $\times$  4–6.5  $\mu$ m, oblongatus, hyalinae. *Pleurocystidia* 30–50  $\times$  5–9.5  $\mu$ m, clavata, hyalinae. *Cheilocystidia* (11–) 21–40  $\times$  4–9  $\mu$ m, clavata, 1–3 apice surculis. *Trama lamellarum* regularis. *Caulocystidia* 22–45  $\times$  5–8  $\mu$ m, cylindraceis. *Holotypus:* INDONESIA.



**Fig. 12.** *Crinipellis malesiana* (AR 491). – 1. Basidiomes (x2). – 2. Basidiospores. – 3. Basidioles. – 4. Cheilocystidia. – 5. Caulocystidia. – 6. Pleurocystidia. – 7. Pileipellis hair. – Bar: 2-7= 10  $\mu$ m.

Central Java, Kabupaten Jepara, Keawatan Karimunjawa, Desa Kanimunjawa, Kawpung alang-alang, Legon Goprak, 13 June 2004, A. Retnowati 491 (BO).

*Pileus* 2–13 mm diam., convex and shallowly umbilicate or papillate when young, becoming broadly convex and papillate to umbonate with age, often with one or two raised concentric ridges surrounding central papilla, striate to sulcate, dull, dry, radially fibrillose-hairy to hispid, hairs extending beyond margin; brown overall when young, becoming dark brown (7F8) at the disc and brown to brownish orange at the margin in age. *Context* < 1 mm thick, pale brown to yellowish white. *Lamellae* adnexed to adnate, close to crowded with 3–4 series of lamellulae, yellowish white to white. *Stipe* 4–22  $\times$  1–2 mm, central, cylindrical, thickened near base, dry, dull, fibrillose-hairy to hispid overall,

insititious, brown overall, slightly paler than the pileus. *Rhizomorphs* absent. *Odor and taste* none.

*Basidiospores* 8–12.5  $\times$  4–6.5  $\mu$ m [ $x_{mr}$  = 11.1–11.4  $\times$  4.9–5.2  $\mu$ m,  $x_{mm}$  = 11.3  $\pm$  0.1  $\times$  5.0  $\pm$  0.2  $\mu$ m,  $Q$  = 1.5–2.7,  $Q_{mr}$  = 2.2–2.3,  $Q_{mm}$  = 2.2  $\pm$  0.1;  $n$  = 25 spores per 3 collections], phaseoliform in side view, oblong in frontal view, smooth, hyaline, inamyloid, thin- to thick-walled. *Basidia* none observed. *Basidioles* 15–34  $\times$  5.5–8  $\mu$ m, clavate to cylindrical with rounded to subacute apex. *Pleurocystidia* 30–50  $\times$  5–9.5  $\mu$ m, projecting up to 15  $\mu$ m beyond basidioles, clavate to fusoid, hyaline, inamyloid, thick-walled, not refractive. *Cheilocystidia* abundant; main body (11–) 21–40  $\times$  4–9  $\mu$ m, clavate to broadly clavate or cylindrical, hyaline, inamyloid, thin- to thick-walled, majority entire, few with 1–3

apical appendages 1–3  $\mu\text{m}$  long. *Pileipellis* a cutis of hyphae 5–6  $\mu\text{m}$  diam., slightly inflated, hyaline to light brown, inamyloid to dextrinoid, slightly thick-walled, giving rise to terminal hairs with basal clamp connections. *Hairs* 175–555  $\times$  2.5–5  $\mu\text{m}$ , cylindrical, apices mostly rounded, few with acute apices, with secondary septations, thick-walled (2–3  $\mu\text{m}$ ), weakly dextrinoid, becoming yellowish green to green in KOH. *Pileus trama* subregular; hyphae 2–8  $\mu\text{m}$  diam., hyaline, inamyloid to weakly dextrinoid near cutis, slightly thick-walled. *Lamellar trama* subregular; hyphae 2–8  $\mu\text{m}$  diam., hyaline, inamyloid, slightly thick-walled. *Stipe tissue* monomitic, parallel, tightly packed; *stipitipellis* composed of repent cortical hyphae, caulocystidia and terminal hairs; *cortical hyphae* 2.5–5  $\mu\text{m}$  diam., cylindrical, thick-walled, dextrinoid, becoming light pea green in KOH; *medullary hyphae* 2–5  $\mu\text{m}$  diam., cylindrical, thin-walled, inamyloid to weakly dextrinoid, hyaline; *caulocystidia* 22–45  $\times$  5–8  $\mu\text{m}$ , thick-walled cylindrical; *terminal hairs* 72–440  $\times$  5–10  $\mu\text{m}$ , cylindrical, apices narrowly rounded, thick-walled, inamyloid to weakly dextrinoid, hyaline to light brown in water, hyaline to light yellowish green in KOH. *Clamp connections* present.

*Habitat*: Scattered to gregarious on woody debris.

*Known distribution*: Indonesia and Malaysia, Thailand.

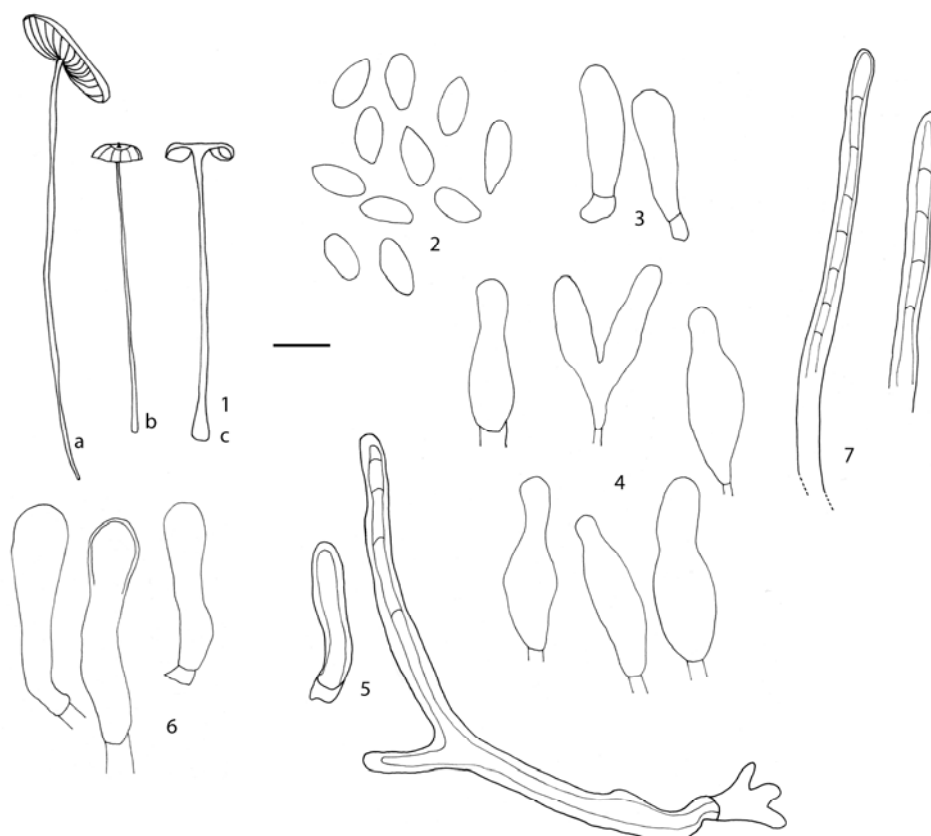
*Material examined*: INDONESIA. Central Java, Kabupaten Jepara, Keeawatan Karimunjawa, Desa Kanimunjawa, Kawpung alang-alang, Legon Goprak, 13 June 2004, A. Retnowati 491 (**Holotype**: BO; **Isotype**: SFSU); Central Java, Kabupatau Jepara, Keeamatan Karimunjawa, Desa Karimunjawa, Legan Lele, 15 June 2004, A. Retnowati 513 (BO; SFSU). MALAYSIA. Kedah, Langkawi Island, Gunung Raya, 13 April 2003, KUM 084a (KLU-M, SFSU); Keha, Langkawi Island, Matchinchang, 1 September 2004, TYS 346 (KLU-M, SFSU).

*Notes*: *Crinipellis malesiana* is characterized by the following combination of features: a dark brown pileus and brown robust stipe; simple, entire cheilocystidia; clavate to fusoid pleurocystidia; pileus hairs and stipe tissue that turn yellowish green in KOH; and elongate-ellipsoid basidiospores with  $Q_{\text{mm}} = 2.2$ . The greening reaction of the tissues in KOH suggests that this species belongs in section *Grisentinae* as established by Singer

(1942, 1976). *Crinipellis malesiana* is similar to *C. atrobrunnea*, another species with a dark brown pileus and relatively long and narrow spores ( $Q = 2.1$ ), described from Vietnam. Cheilocystidia were not recovered in our type analysis of *C. atrobrunnea* (FH!) nor were they reported in Yang's (2000) type study; however, cheilocystidia were reported by Singer (1942) as cylindrical or subfusoid with no branching, or branching up to five or more times (Singer, 1976). *Crinipellis malesiana* is distinguished from *C. atrobrunnea* by the presence of pleurocystidia, and the greening reaction of pileus hairs and stipe tissues. In addition, *C. atrobrunnea* is reported only to grow on Gramineae, whereas *C. malesiana* was found only on wood and dicot twigs. *Crinipellis mirabilis* Singer, described from New Caledonia, also has a brown pileus and hairs that turn green in KOH. It is distinguished from *C. malesiana* by forming slightly smaller basidiospores (9.5  $\times$  4.4  $\mu\text{m}$ ), by lacking distinctive pleurocystidia, and has hairs that are initially purple in KOH but fade to greyish green in time. *Crinipellis hepatica* Corner from Singapore is also similar to *C. malesiana*, but the former differs by forming reddish brown pilei, lacks pleurocystidia, and there is no mention of a green KOH reaction to pileus hairs. The four collections of *C. malesiana* studied by us and included in the molecular analyses form a clade with 100% MP-BS, 100% ML-BS and 1.00 PP support, and sister of *C. scabella* and *C. trichialis* in all analyses. One sequence of an unidentified *Crinipellis* collected in Thailand was downloaded from GenBank (AY916698). The latter sequence also nested in the *C. malesiana* clade with 100% BS and PP support, suggesting strongly that it represents *C. malesiana*. We have not studied voucher material associated with this undetermined GenBank entry. However, these data suggest that the species may range northward from Indonesia to Thailand.

**14. *Crinipellis* aff. *mirabilis*** Singer, Lilloa 8: 497. 1943. (Fig. 13: 1–7)

*Type*: NEW CALEDONIA. Between Col d' Amieu and M gropo, collected by Le Rat #101, 1907, on twigs, det. by Patouillard as *Crinipellis stipitaria* var. *castaneus* (**Holotype**: FH!).



**Fig. 13.** *Crinipellis* aff. *mirabilis* (JFK 137). – 1. Basidiomes (a. x3. – b-c. x2.). – 2. Basidiospores. – 3. Basidioles. – 4. Cheilocystidia. – 5. Caulocystidia. – 6. Pleurocystidia. – 7. Pileipellis hairs. – Bar: 2-7 = 10  $\mu$ m.

#### ***Analysis of the holotype specimen***

The holotype specimen consists of three intact basidiomes, one loose in the packet and two attached to woody sticks. As dried: *Pileus* 4–5 mm diam., conical-papillate, with long shaggy hairs overall, dark brown or reddish brown. *Lamellae* subdistant, seemingly narrow but most are missing, pallid. *Stipe* 25–30  $\times$  0.5 mm, pubescent, dark brown, arising directly from the woody substrate, associated with very narrow, wiry, branched, finely pubescent, dark brown rhizomorphs.

*Basidiospores* (adhered to pileus hairs and stipe apex) 8.3–10.5 (–12)  $\times$  4.2–4.8  $\mu$ m, ellipsoid to subfusoid, hyaline, smooth, inamyloid, thin-walled or in age thick-walled. All hymenial cells were collapsed and degraded; no data on hymenial elements obtainable. *Pileipellis* a cutis giving rise to hairs. *Hairs* 3.2–6.5  $\mu$ m diam., cylindrical with an acute or obtuse apex, thick-walled (0.5–1.5  $\mu$ m), sinuous at the base, with regular, ladder-like secondary septa; walls dark brown to reddish brown in water but immediately greyish olive in 3% KOH, dextrinoid.

#### ***Description based on fresh material***

*Pileus* 1–5 mm diam., when young convex with inrolled margin, papillate, in age becoming convex to plano-convex with papilla in a depressed disc, with 1–3 raised concentric ridges around disc, papilla and ridges less obvious in older specimens; surface radially appressed-fibrillose, margin with appendiculate fibrils; dark reddish brown (7–8F6–8) to violet brown (11F7) when young, in age becoming lighter in colour in zone around the disc to cream at the margin with violet brown (11F7) fibrillose hairs. *Context* < 1 mm thick. *Lamellae* free to adnexed or narrowly adnate, close to subdistant with 1–2 series of lamellulae, narrow, white, non-marginate. *Stipe* 8–22  $\times$  0.5–1 mm, central, terete, cylindrical,  $\pm$  equal, tough, pliant, longitudinally striate, fibrillose, subsinuous; dark reddish brown (7–8F6–8) to violet brown (11F7). *Rhizo-Omorphs* thin, hair-like, glabrous, black. *Odor and taste* none.

*Basidiospores* 8–12  $\times$  3–5  $\mu$ m [ $x_{mr}$  = 9–10  $\times$  3.8–4.8  $\mu$ m,  $x_{mm}$  = 9.5  $\pm$  0.5  $\times$  4.4  $\pm$  0.5  $\mu$ m, Q = 1.8–2.9,  $Q_{mr}$  = 2.0–2.4,  $Q_{mm}$  = 2.2  $\pm$

0.2; n = 11–25 spores per 3 collections], subcylindrical to amygdaliform in side view, few oblong to ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 19–26 × 5–7.5 µm, clavate, 4-spored. *Basidioles* clavate to cylindrical with a few fusiform to subfusiform. *Pleurocystidia* absent. Lamellar edge sterile. *Cheilocystidia* common; main body 26–30 × 5–10 µm, clavate to narrowly ventricose, entire, simple, hyaline, inamyloid, thin-walled or with walls up to 0.5 µm thick. *Pileipellis* a cutis 25–50 × 6–7.5 µm, clavate, slightly thick-walled, weakly dextrinoid, hyaline, giving rise to terminal hairs with basal clamp connections. *Hairs* 87–337 × 2.5–5 µm, cylindrical, very rarely branched, apices rounded to acute, with secondary septations, thick-walled, dextrinoid, purple-violet in water, initially dark purple in KOH, colour fading with time and becoming grey to olive-grey in KOH. *Pileus trama* subregular to regular; hyphae 3–6 µm diam., thin-walled, hyaline in water, distinctly olive in KOH. *Lamellar trama* regular; hyphae 2–6 µm diam, thin-walled. *Stipe tissue* monomitic, parallel, tightly packed; *stipitipellis* composed of repent cortical hyphae, caulocystidia and terminal hairs; *cortical hyphae* 1.5–3 µm diam., cylindrical, thick-walled, dextrinoid, hyaline to light yellow with greenish tints in KOH; *medullary hyphae* 1.5–2 µm diam., cylindrical, thick-walled, strongly dextrinoid, hyaline to light yellow with greenish tints in KOH; *caulocystidia* 57–82 × 5–8.75 µm, cylindrical, some branched, base flexuous, thick-walled, dextrinoid, hyaline to greyish purple in water; *terminal hairs* 162–327 × 5–6 µm, cylindrical, apices rounded or acute, with secondary septations, thick-walled, dextrinoid, greyish purple in KOH, fading to greyish green in time. *Clamp connections* present.

*Habitat*: Scattered on twigs of undetermined dicots in primary forest, and on decomposing dicot leaves (and possibly woody roots) in termite mounds in a bamboo secondary forest.

*Known distribution*: Malaysia, New Caledonia, and Thailand.

*Material examined*: MALAYSIA. Kuala Lumpur, Gombak Field Station, 12 January 2003, Desjardin 7521 (SFSU). NEW CALEDONIA. Between Col d' Amieu and Mégropo, collected by Le Rat # 101, 1907, on twigs, det. by Patouillard as *Crinipellis stipitaria* var. *castaneus* (**Holotype**: FH). THAILAND. Chiang Mai Province,

Mae Taeng Dist., Si Lanna National Park, 4 July 2005, JFK 137 (SFSU).

*Notes*: *Crinipellis mirabilis*, described originally from woody debris in New Caledonia, is a poorly known species represented by a holotype specimen consisting of three basidiomes in rather poor condition and missing most of their lamellae (FH!). We tentatively recognize the Thailand and Malaysian specimens as *C. aff. mirabilis*. Our collections differ from the protologue in forming slightly smaller basidiomes with more violet-brown pigmentation instead of "chestnut brown" or "Mars brown", and growth on leaves instead of twigs. Micromorphologically, the Thai and Malaysian specimens match quite closely the holotype specimen of *C. mirabilis*. Singer reported the basidiospores as 8.5–9 × 3.8–4.2 µm in the protologue, whereas our analysis of the holotype specimen yielded basidiospores in the range 8.3–12 × 4.2–5.0 µm. *Crinipellis mirabilis* is the type species of section *Grisentinae* Singer (1976), a group characterized by hairs that turn green in KOH.

**15. *Crinipellis pseudostipitaria* subsp. *orientalis*** Singer, Lilloa 8: 472. 1943.

(Fig. 14: 1–2)

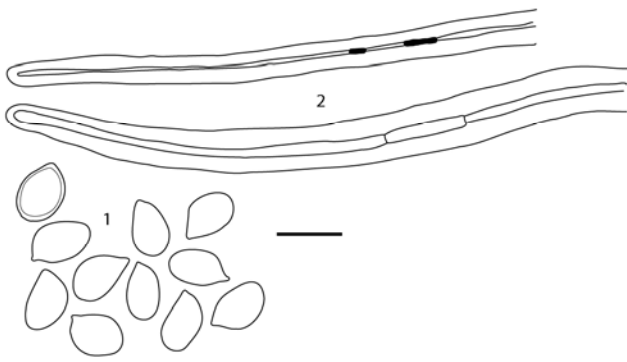
*Type*: VIETNAM (TONKIN), La Pho, 23 July 1909, coll. by Demange #379, on grass debris, det. by Patouillard as *Crinipellis stipitaria* (Holotype: FH!).

***Macromorphological description adapted from the protologue:***

*Pileus* 3–13 mm diam., umbonate, with or without a depression around the papilla, hairy, tan to brown. *Lamellae* attenuated-adnexed to mostly free, moderately crowded to subdistant, medium broad, probably white when fresh. *Stipe* about three times as long as the diameter of the pileus, equal, solid, hairy, concolorous with the pileus.

***Analysis of the holotype specimen***

The holotype specimen consists of four fragmented basidiomes in poor condition, attached to grass stems; separated by Singer from another different species that was part of the original Demange collection. The 4 basidiomes are in a separate packet labeled "type." As dried: *Pileus* 1–3 mm diam, umbonate, silky-shaggy, pallid beige. *Lamellae*



**Fig. 14.** *Crinipellis pseudostipitaria* subsp. *orientalis* (Holotype). – 1. Basidiospores. – 2. Pileipellis hairs. – Bar: 1-2 = 10  $\mu$ m.

absent; all removed. *Stipe* 5–8  $\times$  0.5 mm, pubescent, cream-beige, arising directly from the substrate. *Rhizomorphs* absent.

*Basidiospores* 7.7–9.5  $\times$  5–6  $\mu$ m [ $x_m$  = 8.3  $\pm$  0.5  $\times$  5.5  $\pm$  0.3  $\mu$ m, Q = 1.5–1.3,  $Q_m$  = 1.7  $\pm$  0.3; n = 15 spores per 1 collection], broadly ellipsoid, smooth, hyaline, inamyloid, thin-walled, rarely thick-walled. No hymenial elements observable; all lamellae absent. *Pileipellis* a cutis giving rise to hairs. *Hairs* 4–7  $\mu$ m diam., cylindrical, thick-walled (1.3–3.2  $\mu$ m) to nearly solid with only a tiny or occluded lumen slightly sinuous near the base, narrowing slightly and abruptly near the apex, broadly obtuse; secondary septa not seen, hyaline to yellowish brown, inamyloid to dextrinoid; base of some hairs with granular to plaque-like, thin incrustations, mostly non-incrusted. *Stipitipellis* similar to the pileipellis with similar hairs.

*Habitat*: On grass debris.

*Material examined*: Type: VIETNAM (TONKIN), La Pho, 23 July 1909, coll. by Demange #379, det. by Patouillard as *Crinipellis stipitaria* (FH; holotype).

*Notes*: *Crinipellis pseudostipitaria* subsp. *orientalis* is distinctive because of the grass substrate, broadly ellipsoid spores 5–6  $\mu$ m in diam, and cylindrical, nearly solid hairs. Because no lamellae remained in the holotype specimen, data on cystidia so important in *Crinipellis* taxonomy were unobtainable. Singer (1942) reported the cheilocystidia as rarely simple, with the majority “more or less forked or branched or even almost echinate,” 22–30  $\times$  6–7.5  $\mu$ m. We have not encountered fresh material of this taxon so we can provide no data on hymenium cell morphology.

According to Singer, *C. pseudostipitaria* subsp. *orientalis* is the Eastern Hemisphere’s broad-spored form of *C. pseudostipitaria* subsp. *pseudostipitaria* (ut subsp. *occidentalis* Singer, nom. invalid) from the Western Hemisphere, which has narrower spores. Singer (1942) described *C. pseudostipitaria* var. *mesites* Singer as a form transitional between the two subspecies.

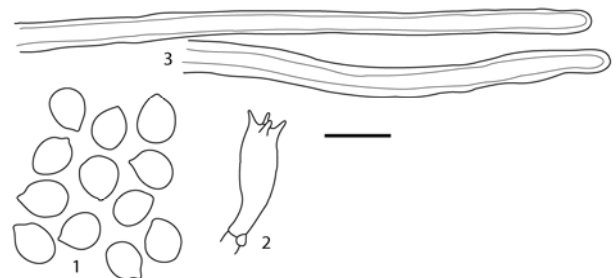
**16. *Crinipellis sepiaria* Pat. & Demange** [ut *saepiarius*], Bull. Soc. Mycol. Fr. 26: 36. 1910. (Fig. 15: 1–3)

$\equiv$  *Marasmius sepiarius* (Pat. & Demange) Sacc. & Trotter. [ut *saepiarius*], Syllog. Fung. 21: 112. 1912.

*Type*: VIETNAM (TONKIN), Hanoi, Sept. 1908, coll. by M. Demange #290, on herbaceous debris and bamboo (Holotype: FH!).

*Macromorphological description adapted from the protologue and from Singer (1942)*:

*Pileus* 10–21 mm diam., convex to plano-convex, umbilicate or depressed at the disc, zonate, radially fibrillose-hairy, margin ciliate; bister, not darker than “snuff brown” or “sayal Brown” when dried (greyish to grey according to Yang, 2000). *Lamellae* narrowly adnexed to subfree, subdistant to distant, thin, moderately broad, white. *Stipe* 20–30  $\times$  1–2 mm, rigid, cylindrical, fibrillose-squamulose to hirsute, brown at the apex becoming brown to black at the base. *Rhizomorphs* absent.



**Fig. 15.** *Crinipellis sepiaria* (Holotype). – 1. Basidiospores. – 2. Basidia and basidioles. – 3. Pileipellis hairs. – Bar: 1-3 = 10  $\mu$ m.

***Analysis of the holotype specimen***

The holotype specimen consists of 6 fragmented basidiomes, pressed flat, in fair condition. As dried: *Pileus* 8–18 mm diam, campanulate with two concentric ridges and depressions surrounding a small umbo, shaggy,

brown to almost dark brown. *Lamellae* subdistant, broad, pale brown. *Stipe* 12–18 × 0.75–1.5 mm, appressed-fibrillose, dark brown.

*Basidiospores* 5.7–7.7 × 4.5–5.7 μm [ $x_m = 6.6 \pm 0.6 \times 5.2 \pm 0.4$  μm,  $Q = 1.2$ –1.5,  $Q_m = 1.3 \pm 0.1$ ;  $n = 20$  spores per 1 collection], broadly ellipsoid to ovoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 4-spored, clavate, clamped. *Basidioles* subfusoid. *Pleurocystidia* absent. Lamellar edges colonised by a deuteromycete; *cheilocystidia* not observable, none recovered. *Pileipellis* a cutis giving rise to hairs. *Hairs* > 300 × 3–6.5 μm, cylindrical, apex not appreciably narrowed, obtuse; thick-walled (0.5–2.3 μm), hyaline to yellowish brown in water, yellowish olive in 3% KOH, dextrinoid; apex of hairs non-incrusted, base of hairs and some subtending hyphae with brown, granular incrustations, a few with secondary septations.

*Habitat*: On herbaceous debris and bamboo in bamboo groves.

*Known distribution*: Vietnam

*Material examined*: VIETNAM (TONKIN), Hanoi, Sept. 1908, coll. by M. Demange #290, on herbaceous debris and bamboo (Holotype: FH).

*Notes*: We have not encountered fresh material of this species so our concept is based on examination of the holotype specimen and data provided in the protologue and in Singer (1942). *Crinipellis sepiaria* is distinctive because of the small ovoid spores, large pilei (up to 20 mm when fresh), and growth on herbaceous debris and bamboo. Our type study matches the data provided by Yang (2000). Singer (1942) mentioned that there is a painting of the type collection by Nguyen Manh Hoan preserved in the Farlow Reference Library, Harvard University. This illustration is reproduced in color microfiche in "Champignons du Tonkin" with an introduction by Don Pfister (1985).

**17. *Crinipellis setipes* (Peck) Singer, Lilloa 8: 493. 1943.** (Fig. 16: 1–6)

= *Agaricus stipitarius* var. *setipes* Peck, N.Y. St. Mus. Rep. 38: 109. 1885.

*Pileus* 2–9 diam. × 1–2 mm tall, hemispherical to convex and subumbilicate when young, becoming convex to plano-convex, subumbilicate with a small papilla that becomes less obvious with age, radially fibrillose, margin distinctly serrulate; disc dark

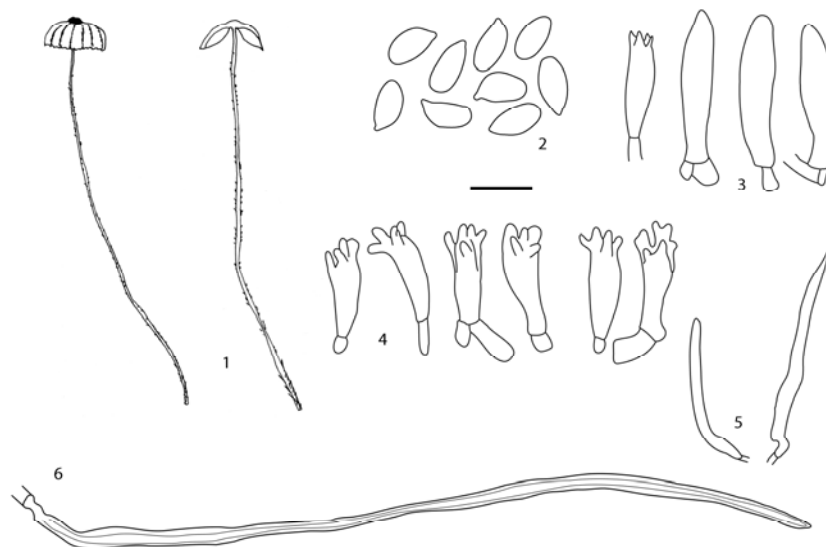
brown (7F7), margin brown (7E7) to cream (4A3), becoming paler with age. *Context* < 1 mm thick, light brown (7D6). *Lamellae* free to adnexed, subdistant to close with 2 series of lamellulae, white. *Stipe* 16–100 × < 1 mm, central, cylindrical, fibrillose, more densely fibrillose near base, light brown with cream-colored (4A3) fibrillose hairs at the base. *Rhizomorphs* thin, black to dark brown (7F8). *Odor and taste* none. *Basidiospores* 7–9 × 4–5 μm [ $x_m = 8.2 \pm 0.6 \times 4.5 \pm 0.5$  μm,  $Q = 1.4$ –2.3,  $Q_m = 1.9 \pm 0.2$ ;  $n = 25$  spores per 1 collection], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 16–24 × 4–6 μm, clavate, 4-spored. *Basidioles* clavate. *Pleurocystidia* absent. Gill edge sterile. *Cheilocystidia* common; main body 12–15 × 4–5 μm, clavate, hyaline, inamyloid, thin-walled, with 4–7 apical appendages; apical appendages 1–3 μm long, hyaline, inamyloid, thin walled. *Pileipellis* a cutis of inflated cells 9–12 μm diam, light tan-brown, giving rise to terminal hairs with basal clamp connections. *Hairs* 50–437 × 4–7.5 μm diam, cylindrical, tapered to acute apices, with few secondary septations, thick-walled (1–2 μm), weakly dextrinoid, light tan-brown in KOH. *Pileus trama* subregular; hyphae 3–5 μm diam., hyaline, inamyloid, thin-walled. *Lamellar trama* regular; hyphae 2–5 μm diam., hyaline, inamyloid, thin-walled. *Stipe tissue* monomitic, parallel, tightly packed; *stipitipellis* composed of repent cortical hyphae and terminal hairs; *cortical hyphae* 2–3 μm diam., cylindrical, thick-walled, strongly dextrinoid, light brownish-green in KOH; *medullary hyphae* 3–5 μm diam., cylindrical, thin-walled, dextrinoid to strongly dextrinoid, hyaline in KOH; *terminal hairs* 77–450 × 5–7.5 μm, cylindrical, thick-walled, strongly dextrinoid, hyaline to light tan-brown in water and KOH. *Clamp connections* present.

*Habitat*: On woody debris in montane cloud forest.

*Known distribution*: China, Thailand, Northeastern North America.

*Material examined*: THAILAND. Chiang Mai Province, Doi Inthanon National Park, Summit of Doi Inthanon, Nature Trail, N18°35.35', E98°29.22', elev. 2542 m, 25 June 2004, Kerekes 34 (CMU, SFSU).

*Notes*: *Crinipellis setipes*, described from northeastern North America and reported from China (Singer 1942) was collected at the



**Fig. 16.** *Crinipellis setipes* (JFK 34). – 1. Basidiomes (x2). – 2. Basidiospores. – 3. Basidia and basidioles. – 4. Cheilocystidia. – 5. Caulocystidia. – 6. Pileipellis hair. – Bar: 2-4, 6 = 10  $\mu$ m; 6 = 25  $\mu$ m.

summit of Doi Inthanon, the tallest point in Thailand (at 2542 meters), among vegetation similar to eastern Himalayan vegetation. This species is nearly indistinguishable from *C. piceae* Singer, and we are following Singer (1942, 1976) and Redhead (1986, 1989) in recognizing the two entities as distinct species. *Crinipellis setipes* differs from *C. piceae* by lacking an obvious basal disc, by growth on dicotyledonous leaf litter and woody debris instead of on spruce needles, and by forming a longer stipe. According to Redhead (1989) *C. piceae* has a circumboreal-bicoastal distribution, whereas *C. setipes* has an amphipacific/asian-Appalachian distribution. Our Thai report of *C. setipes* expands the known geographic distribution of *C. setipes* and confirms an asian-Appalachian distribution. *Crinipellis procera* (Stevenson 1964) is also similar to *C. setipes* in regards to basidiome size, spore size and cheilocystidia morphology, but differs in forming a conical pileus with a conical papilla compared to an umbilicate pileus in *C. setipes*, and lacks rhizomorphs (see type study #31 below). DNA extractions and sequencing were unsuccessful from two specimens of *C. setipes* from North America [(DED 4644 and DED 4318 from Tennessee (both SFSU)]. The Thai specimen of *C. setipes*, collected on undetermined dicot twigs falls in a clade with North American specimens of *C.*

*piceae* from spruce needles with 100 % MP-BS, 98% ML-BS and 1.0 PP support (Fig. 1), and was sister to one of the *C. piceae* specimens (DED 7758) in the parsimony analysis (data not shown), suggesting possibly that the two species are conspecific. Sequences of northeastern North American *C. setipes* populations need to be added to the analyses to clarify their taxonomic status. We have identified our Thai material as *C. setipes* mainly because of the dicotyledonous wood substrate.

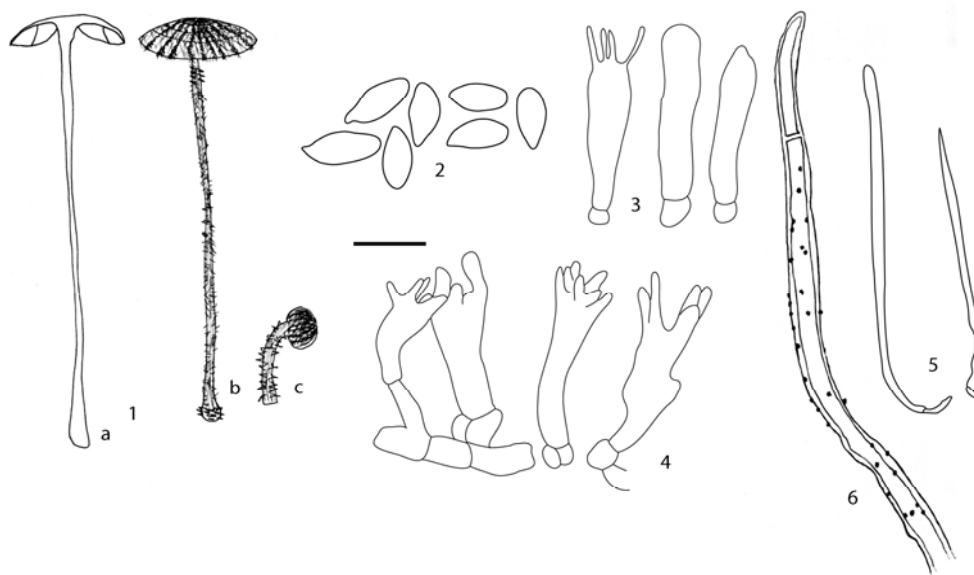
**18. *Crinipellis tabtim*** Kerekes, Desjardin & Lumyong **sp. nov.** (Figs 17: 1–6, 19)  
Mycobank: 512276

*Etymology:* *tabtim* (Thai) = ruby-colored, referring to the pileus color.

*Pileus* 1–11 mm latus, primo hemisphaericus, dein convexus, rubineus. *Lamellae* adnexae. *Stipes* 15–30  $\times$  < 1 mm, cylindricus, fibrillosus, rubrobrunneus. Odor saporque nulli. *Basidiosporae* 8–11  $\times$  4–5.5  $\mu$ m, ellipsoideae, hyalinae. *Basidia* clavata, hyalinae, tetraspora. *Pleurocystidia* nulla. *Cheilocystidia* 10–20  $\times$  5–9  $\mu$ m, clavata, 3–12 apice surculis. *Trama lamellarum* regularis. *Caulocystidia* 88–228  $\times$  3–6  $\mu$ m, cylindraceis. *Holotypus:* THAILAND. Chiang Mai Province, Doi Inthanon National Park, 27 June 2005, JFK 129 (**Holotype:** CMU).

*Pileus* 1–11 mm diam., when young hemispherical to convex with inrolled margin, shallowly umbilicate, becoming plano-convex with concentric ridges around the umbilicus in





**Fig. 17.** *Crinipellis tabtim* (JFK 129). – 1. Basidiomes (a. x3. – b-c. x2). – 2. Basidiospores. – 3. Basidium and basidioles. – 4. Cheilocystidia. – 5. Caulocystidium. – 6. Pileipellis hair. – Bar: 2-4, 6, 7a = 10  $\mu\text{m}$ ; 5 = 50  $\mu\text{m}$ .

age, dull, dry, radially appressed-fibrillose; disc dark violet brown to dark ruby (10–12F7), margin violet brown to ruby (10D–E4), fading to almost cream-coloured at the margin in age. *Context* < 1 mm thick, white, unchanging. *Lamellae* narrowly adnexed to free, close with 2–3 series of lamellulae, white. *Stipe* 15–30  $\times$  < 1 mm, central, terete, cylindrical, equal above, subbulbous at base, longitudinally striate, twisted-fibrous, insititious, dull, dry, fibrillose to hirsute; reddish brown (9E5) to light brown (6D7). *Rhizomorphs* No obvious rhizomorphs, however, some collections with the presence of a white mycelial pad on the leaves. *Odor and taste* none.

*Basidiospores* 8–11  $\times$  4–5.5  $\mu\text{m}$  [ $x_{\text{mr}} = 9.1\text{--}9.3 \times 4.0\text{--}4.1 \mu\text{m}$ ,  $x_{\text{mm}} = 9.2 \pm 0.1 \times 4.1 \pm 0.1 \mu\text{m}$ ,  $Q = 1.8\text{--}2.8$ ,  $Q_{\text{mr}} = 2.2\text{--}2.3$ ,  $Q_{\text{mm}} = 2.3 \pm 0.9$ ;  $n = 25$  spores per 4 collections], lacrymoid to elongate ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* clavate, 4-spored, hyaline, inamyloid, thin-walled. *Basidioles* clavate with rounded to subacute apex. *Pleurocystidia*, absent. *Cheilocystidia* common; main body 10–20  $\times$  5–9  $\mu\text{m}$ , clavate, hyaline, inamyloid, thin-walled, with 3–12 finger-like apical appendages; apical appendages 1–13  $\mu\text{m}$  long, hyaline, inamyloid, thin-walled. *Pileipellis* a cutis of inflated cells 4–10  $\mu\text{m}$  diam., giving rise to terminal hairs with basal clamp connections. *Hairs* 70–140  $\times$  2.5–8  $\mu\text{m}$ , cylindrical, mostly with acute apices, with secondary septations, thick-walled,

dextrinoid, burgundy in water, purplish-grey in KOH and becoming slate blue with time, with golden reddish brown to burgundy incrustations on pileipellis cells and hairs. *Pileus trama* subregular; hyphae 3–7(–18)  $\mu\text{m}$  diam., hyaline, inamyloid, thin-walled. *Lamellar trama* interwoven; hyphae 3–5.5  $\mu\text{m}$  diam., cylindrical, smooth, hyaline, inamyloid, thin-walled. *Stipe tissue* monomitic, parallel, tightly packed; *stipitipellis* composed of repent cortical hyphae and terminal hairs; *cortical and medullary hyphae* 2–5  $\mu\text{m}$  diam., cylindrical, hyaline to yellow-green, dextrinoid; *terminal hairs* 88–228  $\times$  3–6  $\mu\text{m}$ , cylindrical, thin- to thick-walled, weakly dextrinoid, light brown to reddish brown with burgundy tints in water, hyaline to light green in KOH. *Clamp connections* present.

*Habitat*: Scattered on undetermined decomposing dicot leaves.

*Known distribution*: Thailand.

*Material examined*: THAILAND, Nakorn Nayok Province, Khao Yai National Park, 8 July 2005, Kerekes 141 (CMU, SFSU); Chiang Mai Province, Doi Inthanon National Park, 27 June 2005, Kerekes 129 (**Holotype**: CMU; **Isotype**: SFSU); same location, 27 June 2005, Kerekes 134 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Tung Joaw Willage, 30 June 2004, Kerekes 44 (CMU, SFSU).

*Notes*: Diagnostic features of *Crinipellis tabtim* include: a bright burgundy to violet brown or dark ruby-colored pileus with a brown to reddish brown stipe; pileus hairs that turn slate blue in KOH with time; pileipellis cells and hairs with burgundy-colored

incrustations when mounted in water; and cheilocystidia with numerous finger-like projections up to 13  $\mu\text{m}$  in length. The slate blue reaction of the pileus hairs in KOH suggests that this species belongs in section *Iopodinae* subsection *Iopodinae* as circumscribed by Singer (1976). *Crinipellis tabtim* is similar to *C. purpurea* Singer, described from Colombia, but the latter species differs in forming pileus hairs that do not become slate blue in KOH, by forming a deeper purple to purplish black pileus and stipe, slightly shorter basidiospores (mostly  $8.3 \times 3.8\text{--}4 \mu\text{m}$ ), and lacks incrustations on pileipellis hyphae (Singer 1976). *Crinipellis iopus* (see above) differs from *C. tabtim* by forming a bright lilac pileus that bleaches white, and by developing larger basidiospores. In addition, in the ITS analyses (Fig. 1), *C. tabtim* and *C. aff. iopus* are in distant clades; rather, *C. tabtim* and *C. cupreostipes*, two species with distinctly different morphologies, are sister species but with low statistical support (59% MP-BS, 64% ML-BS, .88 PP).

**19. *Crinipellis trichialis*** (Lév.) Pat. ex Antonín, R. Ryoo & H.D. Shin, Mycotaxon 108: 432. 2009. (Figs 18: 1–7, 19)

= *Agaricus trichialis* Lév., Ann. Sci. Nat., Bot. sér. 3, 5: 113. 1846.

= *Naucoria trichialis* (Lév.) Sacc., Syllog. Fung. 5: 853. 1887.

Type: JAVA, Zollinger #2078, on stems of bamboo (**Holotype**: FH!).

*Analysis of the holotype specimen:*

The holotype specimen consists of 3 basidiomes in fair condition, one loose in the packet and two attached to a fragmented bamboo stem, plus 3 stipes attached to the same stem. As dried: *Pileus* ca 3 mm diam., conical to campanulate, shaggy, dark brown. *Lamellae* close, relatively narrow, dark brown. *Stipe* 6–8  $\times$  0.5 mm, non-insititious, tomentose, dark brown, arising directly from the substrate. *Rhizomorphs* absent.

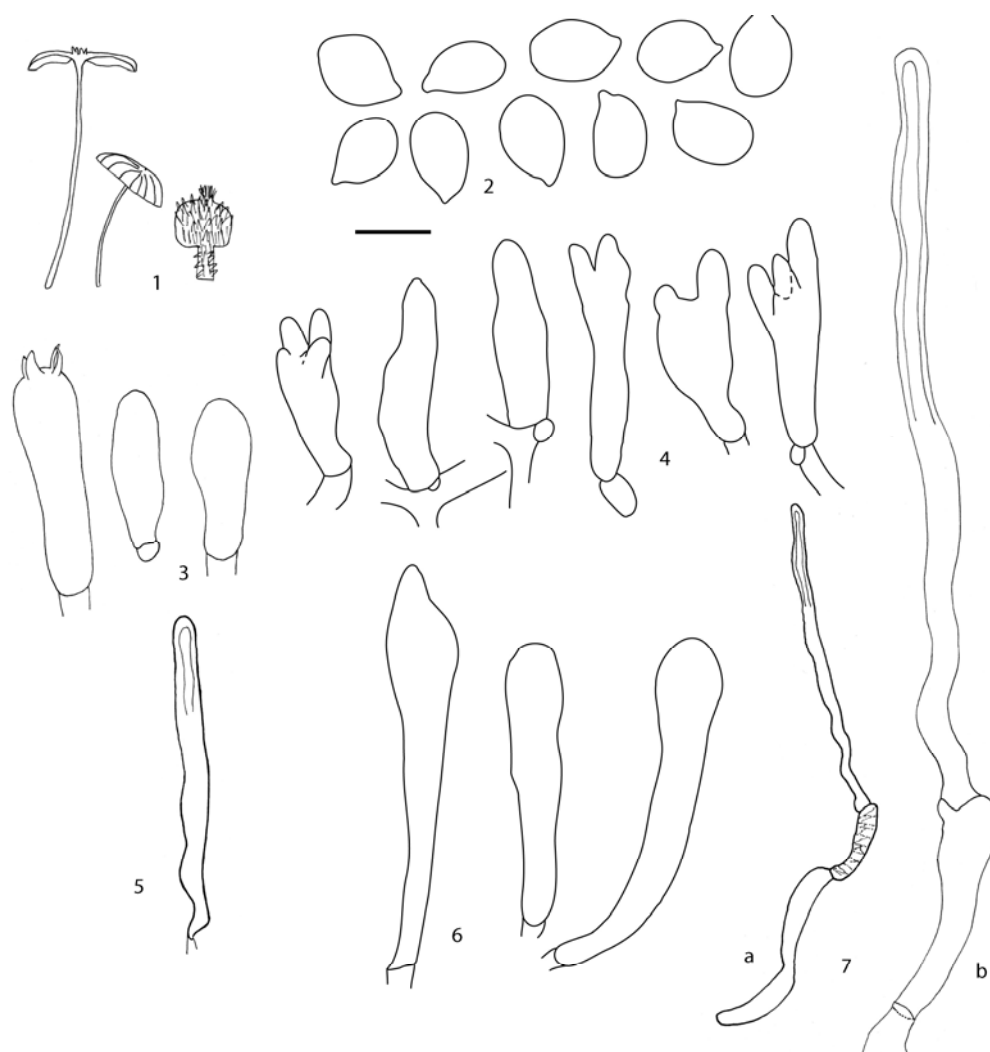
*Basidiospores* (8.5–) 9.6–11.5  $\times$  (5.5–) 6–7 (–7.4)  $\mu\text{m}$  [ $x_m = 10.3 \pm 0.7 \times 6.5 \pm 0.5 \mu\text{m}$ ,  $Q = 1.3\text{--}1.8$ ,  $Q_m = 1.6 \pm 0.1$ ;  $n = 22$  spores per 1 collection], broadly ellipsoid, smooth, hyaline, inamyloid, thin- to thick-walled. *Basidia* 27–32  $\times$  6.2–7  $\mu\text{m}$ , clavate, 4-spored, clamped. *Basidioles* subfusoid. *Pleurocystidia* scattered, clavate to cylindrical, projecting

above basidia, thin- to thick-walled, often with amorphous yellowish brown to brown apical incrustations. *Cheilocystidia* not seen; material too poor and lacking intact lamellar edges. *Pileipellis* cutis giving rise to thick-walled hairs. *Hairs* 3.2–7  $\mu\text{m}$  diam. (avg. 5.5  $\mu\text{m}$ ), cylindrical for most their length, apex gradually narrowed to an obtuse or acute tip, smooth or roughened near apex, base with roughened-granular incrustations, brown in water, olive-brown in 3% KOH, dextrinoid; walls 0.5–2.8  $\mu\text{m}$  thick; secondary septa not seen. *Stipitipellis* similar to pileipellis.

#### *Description based on fresh material*

*Pileus* 5–18 mm diam., hemispherical to convex-cylindrical when young, becoming convex to plano-convex or applanate with age, disc with a tuft of scales forming a small papilla, with concentric zones of erect fibrils or scales around the disc, margin fibrillose; papilla and central zone dark brown (6–7F6–8), middle zone brown (6–7E6–8), margin brownish yellow (5C5–8) or paler. *Context* < 1 mm thick, white. *Lamellae* adnexed to free, close to crowded with 2–4 series of lamellulae, white to pale yellowish white (3A1–2). *Stipe* 6–27  $\times$  0.5–1.5 mm, central, cylindrical, equal with an enlarged base, tough, pliant, fibrillose to hairy overall, insititious, brown to dark brown. *Rhizomorphs* absent. *Odor and taste* none.

*Basidiospores* 6–11  $\times$  5–8  $\mu\text{m}$  [ $x_{mr} = 8.8\text{--}9.8 \times 5.8\text{--}6.3 \mu\text{m}$ ,  $x_{mm} = 9.3 \pm 0.9 \times 6.0 \pm 0.2 \mu\text{m}$ ,  $Q = 1.0\text{--}2.0$ ,  $Q_{mr} = 1.3\text{--}1.6$ ,  $Q_{mm} = 1.5 \pm 0.1$ ;  $n = 10\text{--}25$  spores per 12 collections], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* clavate, 4-spored. *Basidioles* 18–35 (–40)  $\times$  6–8  $\mu\text{m}$ , clavate to cylindrical with rounded to subacute apex. *Pleurocystidia* 31–60  $\times$  6–9  $\mu\text{m}$ , clavate, hyaline, inamyloid, thick-walled. *Cheilocystidia* common; main body 19–32  $\times$  4–10  $\mu\text{m}$ , clavate, simple or a majority with 1–4 apical appendages, hyaline, inamyloid, thin-walled. *Pileipellis* a cutis, 5.5–6  $\mu\text{m}$  diam., hyaline, inamyloid, with spiral encrustations, giving rise to terminal hairs with basal clamp connections. *Hairs* 45–460  $\times$  2.5–5  $\mu\text{m}$  diam., cylindrical, apex rounded to acute, with secondary septations, thick-walled, dextrinoid, yellowish-brown to greenish brown in KOH. *Pileus and lamellar trama* subregular;



**Fig. 18.** *Crinipellis trichialis* (JFK 109). – 1. Basidiomes (x2). – 2. Basidiospores (JFK 108). – 3. Basidia and basidioles. – 4. Cheilocystidia. – 5. Caulocystidia. – 6. Pleurocystidia. – 7a-b. Pileipellis hairs. – Bar: 2-4, 7a = 10  $\mu$ m; 5, 7b = 25  $\mu$ m.

hyphae 3–6  $\mu$ m diam., hyaline, inamyloid, slightly thick-walled. *Stipe tissue* monomitic, parallel, tightly packed; *stipitipellis* composed of repent cortical hyphae and terminal hairs; *cortical hyphae* 1–3  $\mu$ m diam., cylindrical, dextrinoid, light yellow brown to green in KOH; *medullary hyphae* 3–5  $\mu$ m diam., cylindrical, strongly dextrinoid, hyaline; *terminal hairs* 100–325  $\times$  7.5–10  $\mu$ m, cylindrical, apices acute, with secondary septations, dextrinoid, yellowish brown to greenish brown in KOH. *Clamp connections* present.

**Habitat:** Solitary to gregarious, primarily on bamboo or rarely on decomposing dicot sticks.

**Known distribution:** Brazil, Indonesia, Malaysia, Venezuela.

**Material examined:** INDONESIA. Java, Bogor, Bogor Botanical Gardens, S06°35.955', E106°47.720',

elev. 266 m, 7 January 1998, D.E. Desjardin 6716 (BO, SFSU); same location, 15 January 1998, D.E. Desjardin 6800 (SFSU); same location, 12 January 1999, D.E. Desjardin 6924 (SFSU); same location, 6 January 2000, D.E. Desjardin 7043 (SFSU), same location, 12 January 2000, A.W. Wilson 33 (SFSU); same location, 24 February 2000, A. Retnowati 216 (BO, SFSU); same location, 15 January 2005, Kerekes 111 (BO, SFSU); Java, Cibodas, 29 December, 1998, E. Horak (BO; SFSU) (same as AR 045); Java, West of Bogor, Hutan Penelitian, Haurbentes, S06°32.646', E106°26.261', elev. 292 m, 14 January 2005, Kerekes 108 (BO, SFSU); same location, 14 January 2005, Kerekes 109 (BO, SFSU); Java, Buitenzorg, coll. by F. von Hoehnel, on bamboo, det. by Rolf Singer (FH). Java, Zollinger #2078, on stems of bamboo (**Holotype:** FH). MALAYSIA. Selangor, Selayang, Kanching Forest Reserve, N03°17.954' E101°37.153', elev. 110 m, 9 January 2005, Kerekes 97 (SFSU).

**Notes:** Our recently collected specimens, along with the holotype, were from Java, Indonesia with only one collection from Malaysia, where this species appears to be



**Fig. 19.** *Crinipellis* Basidiomes. – 1, 2. *Crinipellis actinophora* (JFK 100) rhizomorphs in the field and basidiomes. – 3. *Crinipellis brunneipurpurea* (JFK 84). – 4. *Crinipellis brunnescens* (DED 6791). – 5. *Crinipellis furcata* (DED 6951). – 6. *Crinipellis trichialis* (JFK 108). – 7. *Crinipellis malesiana* (KUM 084a). – 8. *Crinipellis dipterocarpi* f. *cinnamomea* (JFK 50). – 9. *Crinipellis tabtim* (JFK 44). – 10. *Crinipellis cupreostipes* (JFK 31). – 11. *Crinipellis cupreostipes* (JFK 131). – 12. *Crinipellis* aff. *iopus*. – 13. *Crinipellis dipterocarpi* (JFK 51).

restricted to dead Bambuseae. Distinguishing characteristics are the concentric zones of color on the pileus with long, erect, hispid hairs around the disc, the presence of pleurocystidia, and the green KOH reaction of the pileus hairs and stipe tissues. Singer (1976, 1986) placed *C. trichialis* in section *Grisentinae* because of the green KOH reaction. Our molecular data, however, indicate that *C. trichialis* is sister of *C. scabella* (type species of the genus), a species that lacks a green KOH reaction, one of the defining features of sect. *Crinipellis*.

The holotype specimen from Java (Zollinger #2078, FH) is incorrectly labeled as “*Agaricus trichophorus* Lév.”, which indicates a different species collected by Zippelius from Java on wood. The latter (*Ag. trichophorus* Zipp. ex Lév., Ann. Sci. Nat., Bot. sér. 3, 2: 171. 1844) is probably a species of *Mycena* (Pers.) Roussel or *Hemimycena* Singer with a white pileus bearing setae and a glabrous stipe.

**20. *Moniliophthora canescens*** (Har. Takah.) Kerekes & Desjardin, **comb. nov.**

(Fig. 20: 1–5, 24)

Mycobank: 513037

Basionym: *Crinipellis canescens* Har. Takah., Mycoscience 41: 171. 2000.

Type: JAPAN, Iriomote Island, Okinawa Pref., along the Urauchi River, 2 June 1999, solitary to scattered on a dead fallen twig of broad-leaved tree, KPM-NC-0005014 (Holotype: CBM). Type not examined.

*Description based on fresh material:*

*Pileus* 9–15 mm diam., broadly convex to plano-convex, umbilicate, sulcate, appressed-radially-fibrillose, dull, dry; dull greyish orange (5B5–6) overall. *Context* thin, pliant. *Lamellae* adnate, distant with 1–2 series of lamellulae, broad (1–2 mm), bright orange (5A6–8). *Stipe* 5–10 × 0.75–1 mm, central, terete, cylindrical, ± equal, curved, hispidulous overall, insititious, often arising from a thin white subiculum: brownish grey (6C3) overall. *Rhizomorphs* thin, wiry, black, glabrous rhizomorphs; rhizomorphs adhere masses of twigs and debris together, arboreal. *Odor and taste none* *Basidia* 22–28 × 5–7 μm, clavate, 4-spored. *Basidioles* clavate. *Pleurocystidia* absent. Gill edge heteromorphous with few cheilocystidia. *Cheilocystidia* with main body 20–27 × 4–6 μm, clavate to irregular, simple or

with up to 3 apical appendages 2–5 μm long, hyaline, inamyloid, thin-walled. *Pileipellis* a cutis of inflated cells 27–50 × 6–10 μm with dextrinoid incrustations, hyaline to light brown in KOH, giving rise to terminal hairs with basal clamp connections. *Hairs* few and relatively short, 87.5–115 × 6–8 μm, thick-walled (2–3 μm), lacking secondary septations, hyaline to yellow with orange tints in water, hyaline in KOH. *Clamp connections* present.

*Basidiospores* 7–10 × 4–5 μm [ $x_m = 8.5 \pm 0.7 \times 4.1 \pm 0.3 \mu\text{m}$ ,  $Q = 1.6\text{--}2.3$ ,  $Q_m = 2.1 \pm 0.3$ ;  $n = 25$  spores per 1 collection], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Habitat:* Basidiomes rare, rhizomorphs common, on undetermined dicot plants in primary forest. *Known distribution:* Iriomote Island (southwestern Japan), Malaysia.

*Material examined:* MALAYSIA. Kuala Lumpur, Gombak Field Station, 12 Jan. 2003, D.E. Desjardin 7518 (SFSU).

*Notes:* We requested the type collection on loan from Japan, however it was not available for examination. Our material from Malaysia matches nicely with the protologue of *C. canescens*. The ITS sequence data (Fig.1) for DED 7518 indicate that the species belongs in the *Moniliophthora* clade with 53% ML-BS and .50 PP support. Based on the micro- and macromorphological characteristics and ITS sequence data, we recognize *Crinipellis canescens* as belonging to the genus *Moniliophthora* and make the formal transfer herein.

**21. *Moniliophthora marginata*** Kerekes, Desjardin & Vikineswary, **sp. nov.**

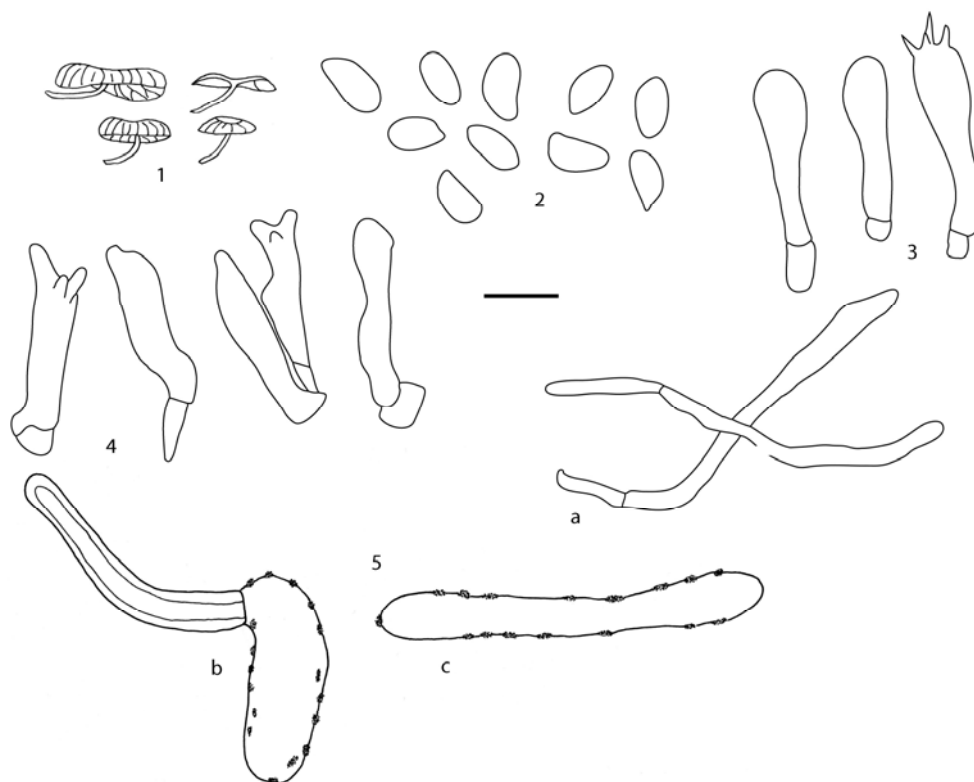
(Fig. 21: 1–6, 24)

Mycobank: 512277

*Etymology:* marginatus (Latin) – margined, referring to the brownish-red margins of the lamellae.

*Pileus* 22 mm latus, flabelliformis, rubrobrunneus. *Lamellae* liberae, marginatus rubrobrunneus. *Stipes* 6–8 × 1 mm, cylindricus, fibrillosus, rubrobrunneus. *Odor* saporque nulli. *Basidiosporae* 5–10 × 3–5 μm, oblongatae, hyalinae. *Basidia* 35–36 × 6 μm, clavata, hyalinae, tetraspora. *Pleurocystidia* nulla. *Cheilocystidia* 19–40 × 4–7, clavata. *Trama lamellarum* regularis. *Caulocystidia* 60–150 × 5–6.25 μm, cylindraceis. *Holotypus:* MALAYSIA. Pahang Province, Fraser’s Hill, Bishop’s trail, N03°42.949', E101°44.430', elev. 1212 m, 15 January 2005, Kerekes 15 (**Holotype:** KLU-M).

*Pileus* 22 mm diam., circular to rounded flabelliform, centrally depressed,



**Fig. 20.** *Moniliophthora canescens* (DED 7518). – 1. Basidiomes. – 2. Basidiospores. – 3. Basidium and basidioles. – 4. Cheilocystidia. – 5a-b. Pileipellis hairs. – 5c. Pileipellis hair subtending cell. – Bar: 2-4, 5b, 5c = 10  $\mu$ m; 5a = 25  $\mu$ m.

sulcate, with scaly or wart-like tufts of fibrils concentrated near the disc, interwoven appressed-fibrillose elsewhere; reddish brown (9D–F6), darkest near disc (9F6) and lighter towards margin, interwoven hairs range from reddish brown (9F6) to light reddish brown (9D6). *Context* < 1 mm thick, brownish violet (11D6). *Lamellae* free, close with 3 series of lamellulae, narrow (1–2 mm), off white with brownish red (10D6) edges. *Stipe* 6–8  $\times$  1 mm, central, cylindrical, fibrillose to squamulose, insititious; apex white, becoming brownish red (10D6) below. *Odor and taste* none.

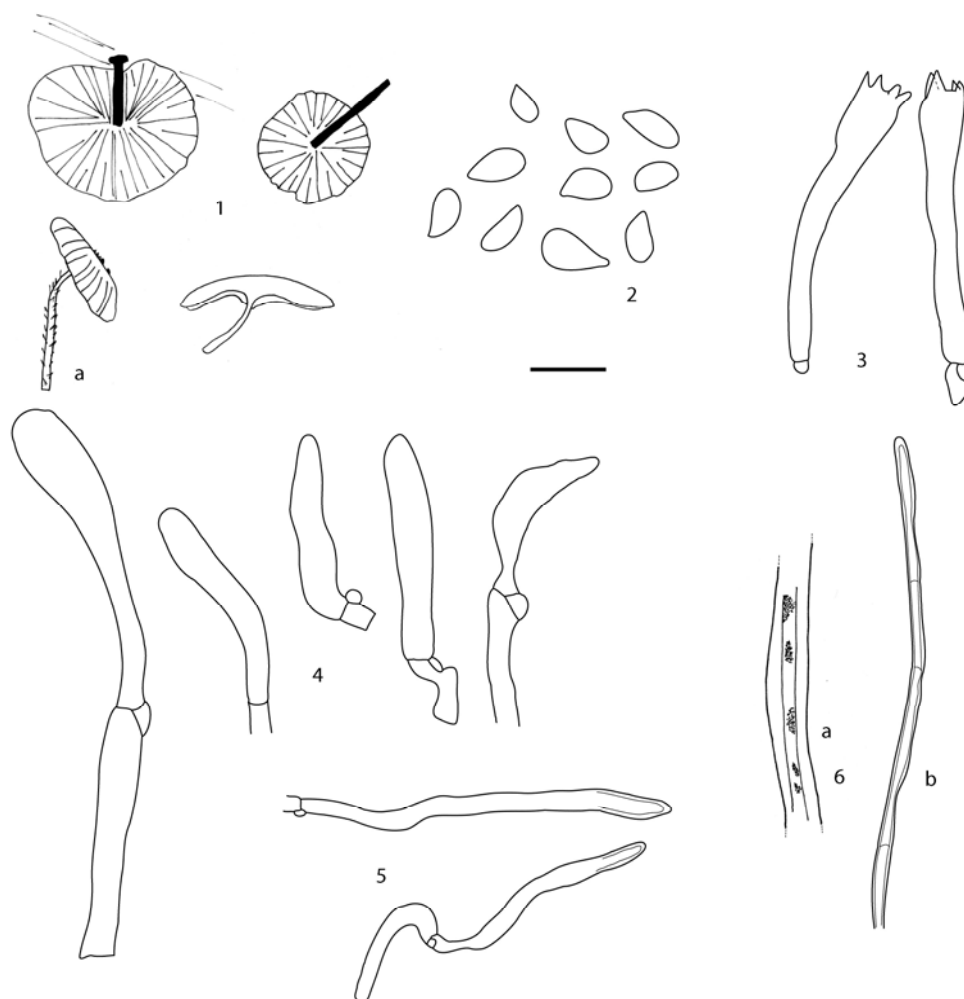
*Basidiospores* 5–10  $\times$  3–5  $\mu$ m [ $x_m = 7.0 \pm 1.0 \times 4.0 \pm 0.6 \mu$ m,  $Q = 1.3–2.3$ ,  $Q_m = 1.8 \pm 0.3$ ;  $n = 25$  spores per 1 collection], oblong with some tapering towards the apex to amygdaliform in side view, smooth, hyaline, inamyloid, thin-walled. *Basidia* 35–36  $\times$  6  $\mu$ m, clavate, 4-spored, thin-walled to slightly thick-walled. *Basidioles* clavate. *Pleurocystidia* absent. *Cheilocystidia* with main body 19–40  $\times$  4–7  $\mu$ m, narrowly cylindrical to clavate, lacking obvious apical appendages although some with small knobs near the apex, hyaline to brown, weakly dextrinoid, partially thick-walled, most basally clamped. *Pileipellis* a

cutis to a trichoderm with inflated chains of hyaline cells 28–60  $\times$  6.5–11  $\mu$ m, coarsely incrustated, giving rise to terminal hairs with basal clamp connections. *Hairs* 50–337  $\times$  5–10  $\mu$ m, cylindrical, apices generally rounded, some with secondary septations, thick-walled, strongly dextrinoid, purple in KOH. *Pileus trama* regular; hyphae 3–7  $\mu$ m diam., hyaline, weakly dextrinoid near hairs, thin-walled. *Lamellar trama* regular; hyphae 2.5–9  $\mu$ m diam., hyaline, inamyloid, thin-walled. *Stipe tissue stipitipellis* composed of repent cortical hyphae and terminal hairs; *cortical hyphae* 1.5–4  $\mu$ m diam., cylindrical, pale yellowish brown to hyaline, dextrinoid, thin-walled; *medullary hyphae* 1–3  $\mu$ m diam., cylindrical, hyaline, dextrinoid, thin-walled; *terminal hairs* 60–150  $\times$  5–6  $\mu$ m, cylindrical, apices rounded, some with secondary septations, thick-walled, dextrinoid, purple to hyaline in KOH. *Clamp connections* present.

*Habitat*: In a primary montane cloud forest on undetermined decaying woody stem.

*Known distribution*: Malaysia.

*Material examined*: MALAYSIA. Pahang Province, Fraser's Hill, Bishop's trail, N03°42.949', E101°44.430', elev. 1212 m, 15 January 2005, Kerekes 15 (**Holotype**: KLU-M; **Isotype**: SFSU).



**Fig. 21.** *Moniliophthora marginata* (JFK 15). – 1. Basidiomes (a. x2). – 2. Basidiospores. – 3. Basidia. – 4. Cheilocystidia. – 5. Caulocystidia. – 6a. Pileipellis hair segment. – 6b. Pileipellis hair. – Bar: 2-4, 6a = 10  $\mu$ m; 5, 6b = 25  $\mu$ m.

*Notes:* DNA was extracted from specimen JFK 15, however, sequencing was not successful; therefore placement of *M. marginata* in the phylogenetic tree is unknown. Features of *M. marginata* suggest a close affinity with members of *Crinipellis* sect. *Iopodinae* of which many members are currently accepted in *Moniliophthora*. This species is close to *Crinipellis eggersii* Pat., but the latter differs by forming larger basidiospores (11–13  $\times$  5.5–6.3  $\mu$ m) and forms purple to violet purple basidiomes (Singer 1976). We suspect that *C. eggersii* belongs in the genus *Moniliophthora* as originally suggested by Aime and Phillips-Mora (2005), but a formal transfer will not be made until material from Ecuador (type locality) is studied. *Moniliophthora marginata* is also similar to *C. trinitatis* Dennis (sect. *Iopodinae*), described from Trinidad, but the latter species differs in

forming forked cheilocystidia, and grows on living *Vitex* trees (Singer, 1976).

**22. *Moniliophthora nigrilineata*** (Corner) Desjardin & Kerekes, **comb. nov.**

(Fig. 22: 1–2)

Mycobank: 513038

Basionym: *Crinipellis nigrilineata* Corner, Beih. Nova Hedwigia 111 120. 1996.

*Type:* SINGAPORE, Mandai Road, 15 Oct. 1934, coll. by E.J.H. Corner, record #192520 (**Holotype:** E!).

***Analysis of the holotype specimen***

The holotype specimen consists of > 10 badly fragmented basidiomes, pressed flat, in poor condition. As dried: *Pileus* 4–8 mm diam. (10–35 mm diam in protologue when fresh), ranging from clay-color to brown, hirsute. *Lamellae* adnate to subdecurrent, close to



**Fig. 22.** *Moniliophthora nigrilineata* (E.J.H. Corner, record #192520). – 1. Basidiospores. – 2a. Pileipellis hairs. – 2b. Pileipellis cell subtending a terminal hair. – Bar: 1-2 = 10  $\mu$ m.

distant, narrow to moderately broad, pallid to brown. *Stipe* 8–16  $\times$  0.5 mm, pruinose, dark brown at base, arising directly from the substrate; *rhizomorphs* absent.

*Basidiospores* 9–12.8  $\times$  3.5–4.5  $\mu$ m [ $x_m = 11 \pm 1.4 \times 4.0 \pm 0.4 \mu$ m,  $Q = 2.3$ –3.0,  $Q_m = 2.7 \pm 0.4$ ;  $n = 10$  spores per 1 collection], elongate-ellipsoid to subfusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* clavate, 4-spored. *Basidioles* subfusoid. *Pleurocystidia* absent. *Cheilocystidia* absent; lamellar edge fertile. *Pileipellis* 8–19  $\mu$ m diam., inflated, short-celled, smooth or brown-incrustated, hyaline or often with brown plasmatic pigments, inamyloid, unchanged in KOH, thin-walled giving rise to hairs. *Hairs* 60–110  $\times$  5.5–6.5  $\mu$ m, few, scattered, irregularly cylindrical, obtuse, evenly orange-brown or with paler base; thick-walled (1–3  $\mu$ m), smooth, hyaline, inamyloid to weakly dextrinoid, unchanged in KOH.

*Notes:* The pileipellis anatomy is unlike that of *Crinipellis*, in that it lacks numerous long, narrow, dextrinoid skeletal hairs. In addition, the lamellae were reported as subdecurrent, furcated and connected by shallow veins. These features in combination with the elongated, subfusoid basidiospores and an absence of cheilocystidia indicate that the species is better placed in the genus *Moniliophthora*, and a formal transfer is made herein. This species is not included in the phylogenetic analysis because extraction of

DNA from the type specimen was not permitted.

**23. *Marasmiellus subochraceus* (Corner), Kerekes & Desjardin **comb. nov.****

(Fig. 23: 1–5, 24)

Mycobank: 513039

Basionym: *Crinipellis subochracea* Corner, Beih. Nova Hedwigia 111: 121. 1996.

*Type:* SINGAPORE, Reservoir Jungle, 1 Aug. 1940, coll. by E.J.H. Corner, record #192521 (Holotype: E!).

***Analysis of the holotype specimen***

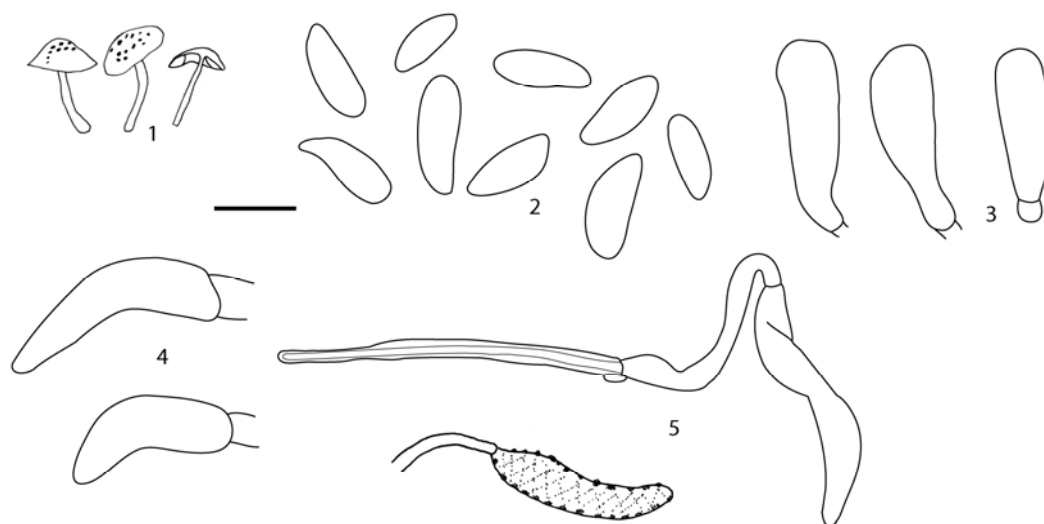
The holotype specimen consists of one half of one pileus attached to a stipe, plus one stipe lacking a pileus, both attached to a woody stick; in poor condition. As dried: *Pileus* 3 mm diam, pallid, hirsute with white to golden hairs. *Lamellae* not observable. *Stipe* 5  $\times$  < 0.5 mm, fibrillose, brown, insititious, arising directly from the substrate. *Rhizomorphs* absent.

*Basidiospores* 9.6–12  $\times$  3.5–4.2  $\mu$ m ( $n=5$ ), subfusoid to clavate, smooth, hyaline, inamyloid, thin-walled. *Hymenial elements* not recovered; material revived poorly. No basidia, basidioles or cystidia observed. *Pileipellis* a cutis of inflated cells giving rise to terminal hairs. *Hairs* ranging from cylindrical to ventricose, 60–180  $\mu$ m long, base 4–10  $\mu$ m diam, apex 2–3.2  $\mu$ m diam, gradually narrowed to a subacute tip; walls hyaline, inamyloid, smooth, 0.5–3  $\mu$ m thick. *Subtending hyphae* inflated, 9–16 (–25)  $\mu$ m, hyaline, inamyloid, thin-walled; some terminal cells like the subtending hyphae, fusoid to clavate, hyaline, thin-walled.

***Macromorphological description based on fresh material:***

*Pileus* 4–10 mm diam, convex, disc with dark brown, powdery-fibrous patches or spots, margin with scattered dark brown, short hairs, ground color white and appressed-silky under ornamentation. *Context* < 1 mm thick. *Lamellae* narrowly adnate, subdistant to distant with 1–2 series of lamellulae, moderately broad, white. *Stipe* 5–10  $\times$  1 mm, central, terete, cylindrical,  $\pm$  equal, curved, tough, dull, dry, silky, subsinititious, white with an incarnate (pink) base. *Odor and taste* none.





**Fig. 23.** *Marasmiellus subochraceus* (DED 7523). – 1. Basidiomes (x1). – 2. Basidiospores. – 3. Basidioles. – 4. Pileipellis terminal cells. – 5. Pileipellis hairs and Pileipellis subtending cell. – Bar: 2-4 = 10  $\mu$ m; 5 = 25  $\mu$ m.

**Micromorphological description based on data from the holotype specimen and fresh material**

*Basidiospores* 10.0–15  $\times$  4–6  $\mu$ m [ $x_{mr}$  = 10.0–12.5  $\times$  3.8–4.5  $\mu$ m,  $x_{mm}$  = 11.2  $\pm$  1.8  $\times$  4.2  $\pm$  0.5  $\mu$ m, Q = 1.9–3.8,  $Q_{mr}$  = 2.6–2.8,  $Q_{mm}$  = 2.7  $\pm$  0.1; n = 5–25 spores per 2 collections], subfusoid to clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia and basidioles* 18–24  $\times$  6–8  $\mu$ m; basidia clavate, 4-spored; basidioles clavate. *Pleurocystidia* absent. *Cheilocystidia* absent, gill edge fertile. *Pileipellis* a cutis of inflated cells, 45–85  $\times$  12–13.5  $\mu$ m clavate to allantoid, with encrustations, dextrinoid, light tan to yellowish tan in KOH, giving rise to terminal hairs with basal clamp connections. *Hairs* sparse, 60–205  $\times$  4–10  $\mu$ m, cylindrical to ventricose, generally rounded at apex or gradually narrowing to a subacute apex, lacking secondary septations, thick-walled (0.5–3  $\mu$ m), inamyloid, light brown in KOH. Subtending hyphae inflated, 9–16 (–25)  $\mu$ m diam., hyaline, inamyloid, thin-walled; some terminal cells like the subtending hyphae, fusoid to clavate, hyaline, thin-walled. *Pileus trama* hyphae 3–9  $\mu$ m diam., cylindrical, hyaline, inamyloid. *Lamellar trama* hyphae 2–6  $\mu$ m diam., cylindrical, hyaline, inamyloid. *Stipe tissue* monomitic, parallel. No obvious difference between the cortical and medullary hyphae, 2–5  $\mu$ m diam., cylindrical, hyaline, inamyloid, thin-walled; no terminal hairs observed. *Clamp connections* present.

*Notes:* The pileipellis anatomy of scattered inamyloid hairs in combinations with broadly clavate, thin-walled, inamyloid cells is not characteristic of *Crinipellis*. These features, in combination with a white pileus, forked lamellae, the absence of hymenial cystidia, and subfusoid basidiospores indicate that the species is better placed in the genus *Marasmiellus*, sect. *Stenophylloides* Singer. In preliminary parsimony analyses, *M. subochraceus* was sister to a clade containing *Crinipellis* and *Moniliophthora* species with low bootstrap support, no PP support, and on a very long branch, whereas in preliminary maximum likelihood analyses *M. subochraceus* nested within the *Crinipellis* clade without statistical support and on a very long branch. Because of its divergent sequence and consistent placement on a long branch in all analyses, *M. subochraceus* was not included in the final ML analyses. Based on overall morphological similarity we recognize *C. subochracea* as belonging to the genus *Marasmiellus* and a formal transfer is made herein.

*Habitat:* Scattered on dead twigs of undetermined dicot tree in primar forest.

*Known Distribution:* Malaysia, Singapore.

*Material examined:* MALAYSIA. Kuala Lumpur, Gombak Field Station, 12 January 2003, D.E. Desjardin 7523 (SFSU). SINGAPORE. Reservoir Jungle, 1 August 1940, coll. by E.J.H. Corner, record #192521 (**Holotype:** E).



**Fig. 24.** *Moniliophthora* basidiomes. – 1. *Moniliophthora marginata* (JFK 15). – 2. *Moniliophthora canescens* (DED 7518). – 3. *Marasmiellus subochraceus* (DED 7523).

### Excluded and Insufficiently Known Taxa, Including Relevant Type Studies of Extralimital Species

**24. *Agaricus omotrichus*** Berk., London J. Bot. 2: 510. 1843. (Fig. 25: 1–3)

≡ *Collybia omotricha* (Berk.) Sacc., [ut *homotricha*] Syllog. Fung. 5: 217. 1887.

≡ *Crinipellis omotricha* (Berk.) D.A. Reid [ut *homotricha*], Contr. Bolus Herb. 7: 111. 1975.

*Type:* SOUTH AFRICA, Uitenhage, December, H. Zeyher #111, on decayed grasses (Holotype: K!).

#### *Analysis of the holotype specimen*

The holotype specimen consists of 4 basidiomes in fair condition, attached to grass stems; one basidiome cut in half lengthwise and only half remains. As Dried: *Pileus* 6–8 mm diam., convex, short-shaggy, dirty brown. *Lamellae* distant, broad, dark brown. *Stipe* 10–15 × 1–1.5 mm, shaggy, brown, arising directly from substrate; rhizomorphs absent.

*Basidiospores* 9–10.2 × 4.2–5.5 μm, [ $x_m = 9.6 \pm 0.5 \times 4.9 \pm 0.4 \mu\text{m}$ ,  $Q = 1.7\text{--}2.4$ ,  $Q_m = 2.0 \pm 0.2$ ;  $n = 10$  spores per 1 collection], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* clavate, 4-spored. *Basidioles* clavate to subfusoid. *Pleurocystidia* absent.

*Cheilocystidia* scattered, lamellar edge fertile; 30–37 × 6.5–8.5 μm, clavate to lageniform, obtuse, simple (non-diverticulate), hyaline, thin-walled. *Pileipellis* of tangled to subparallel, thick-walled hairs. *Hairs* 3.2–5.5 μm diam., rather short (< 200 μm), cylindrical to sinuous below, gradually tapered to a narrow, subacute tip, apically thin-walled, base 0.5–2.2 μm thick, hyaline to yellow, inamyloid to weakly dextrinoid, smooth.

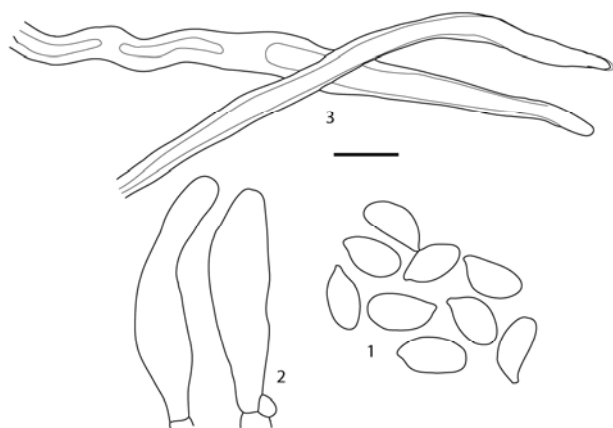
*Habitat:* On decayed grasses.

*Known distribution:* South Africa; reported from Sri Lanka.

*Notes:* This is considered a good species of *Crinipellis*, distinct because of the moderately large spores, short pileipellis hairs, simple cheilocystidia and grass habit.

*Additional material examined:* SRI LANKA. Peradeniya, May 1844, Gardner #10, on the ground (K); Colombo, Victoria Park, 7 May 1981, coll. by C. Dharma-Wardana, (DAOM 189041). Cited by Berkeley (1847) and Pegler (1986), respectively, as contaxic with *Agaricus omotrichus*.

The material from Peradeniya (Gardner #10), did not provide much taxonomically important data, however the pileipellis hairs of this specimen are distinctly different from those of the holotype of *A. omotrichus* (K!),



**Fig. 25.** *Agaricus omostrichus* (Holotype). – 1. Basidiospores. – 2. Cheilocystidia. – 3. Pileipellis hairs. – Bar: 1-3 = 10  $\mu\text{m}$ .

such that this specimen should not be considered as belonging to that species. The hairs of Gardner #10 are more similar to the grass inhabiting *Crinipellis pseudostipitaria* subsp. *orientalis* Singer, described from Vietnam. The specimen collected in Colombo (DAOM 189041) is also not contaxic with the holotype specimen of *A. omostrichus*. The latter has clavate, simple cheilocystidia, thinner-walled pileipellis hairs, and larger basidiospores. The Colombo material at DAOM probably represents an eastern form of *Crinipellis pseudostipitaria*, as it was originally annotated by Redhead. However, it does not represent *C. pseudostipitaria* subsp. *orientalis*, which has larger basidiospores (Holotype: FH!).

**Status:** Based on the data on hand, *C. omostricha* does not occur in Southeast Asia.

**25. *Collybia multicolor*** Petch, Ann. Roy. Bot. Gard., Peradeniya 6: 197. 1917. (Fig. 26: 1)

≡ *Crinipellis multicolor* (Petch) Pegler, Kew Bull. Add. Ser. 12: 139. 1986.

**Type:** SRI LANKA, Hakgala, May 1910, T. Petch # 3053, ex alcohol (**Holotype:** K!).

**Analysis of the holotype specimen:**

The holotype specimen consists of 2 fragmented basidiomes, pressed flat, in poor condition. **As dried:** *Pileus* 9–11 mm diam, plano-convex with a depressed disc, hirsute with erect, minutely fascicled hairs, dark brown. *Lamellae* subdistant, very broad, some with white-crystalline edges, dark brown. *Stipe* 15  $\times$  2 mm, densely pubescent, olive-brown, arising directly from the substrate; *rhizomorphs* absent.

All hymenial elements golden brown in 3%KOH; not reviving well. Hyphal pegs absent. Basidiospores, basidia, basidioles and cystidia not recovered. *Pileipellis* of erect, agglutinated-fasciculate, < 100  $\times$  4–8  $\mu\text{m}$ , cylindrical below, gradually tapered to a narrower, obtuse apex, thin- to thick-walled, hyaline to brown, inamyloid. *Pileus* and *lamellar trama* of gelatinized hyphae 4–16  $\mu\text{m}$  diam., with walls 2–6.5  $\mu\text{m}$  thick, irregularly cylindrical, hyaline, inamyloid.

**Habitat:** On dead vegetable matter and dead wood.

**Known distribution:** Sri Lanka.

**Notes:** This is not a *Crinipellis* species as established by Pegler (1986). The non-dextrinoid and very short pileipellis hairs, in combination with the gelatinized skeletal tramal hyphae up to 6.5  $\mu\text{m}$  thick indicate that the species is closer to *Lentinus* Fr. or *Panus* Fr. **Status:** Without better material to analyze, *C. multicolor* will have to remain as an insufficiently known species.

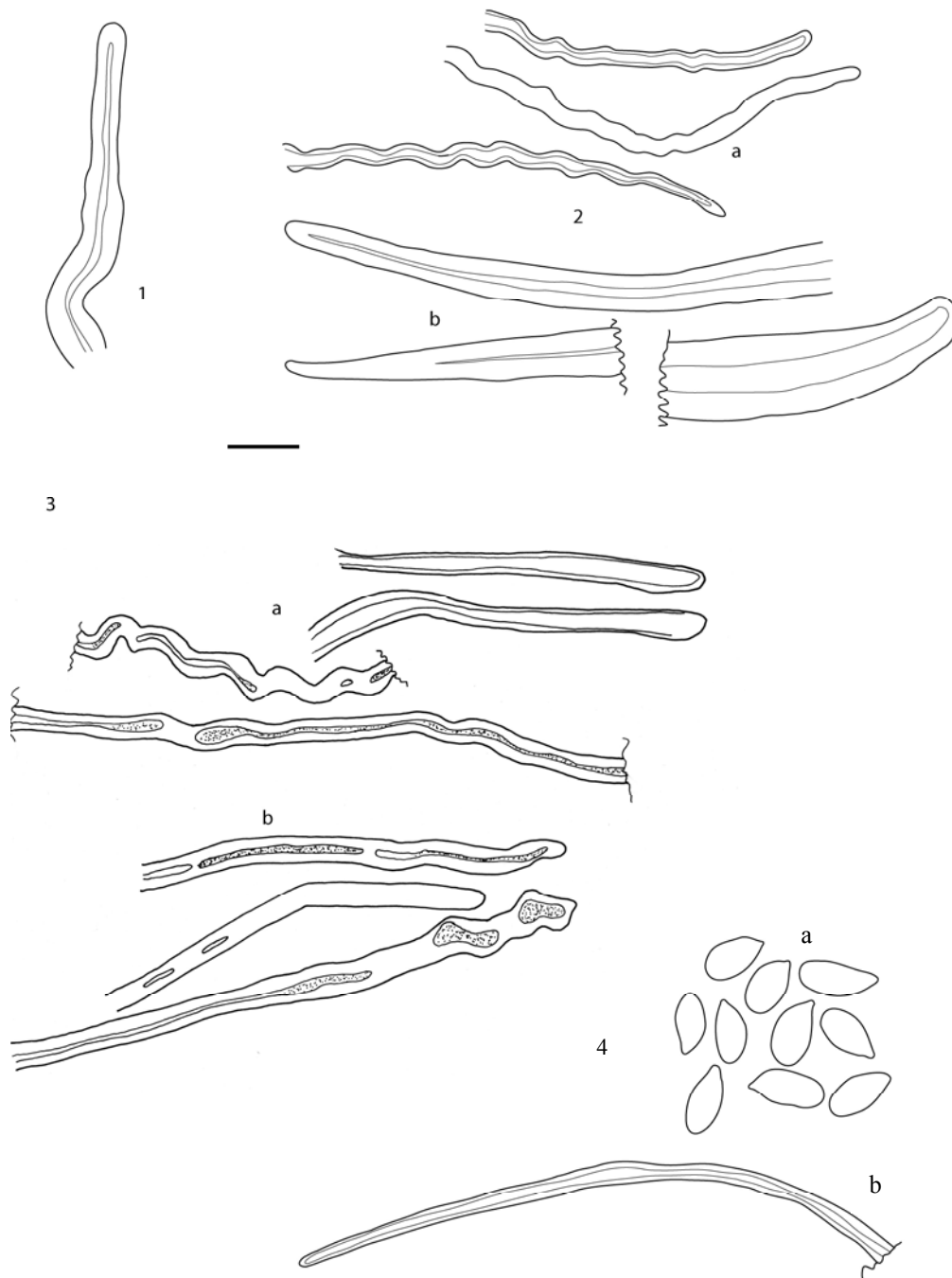
**26. *Crinipellis carecomoeis* var. *subelata*** Singer, Lilloa 8: 488. 1943. (Fig. 26: 2)

**Type:** NEW CALEDONIA, Col d'Amieu, 1907, coll. by Le Rat, det. by Patouillard as *Crinipellis stipitaria* var. *castaneus*, on fallen leaves (**Holotype:** FH!).

**Analysis of the holotype specimen:**

The holotype specimen consists of one intact basidiome plus two stipes attached to leaf fragments, in poor condition. **As dried:** *Pileus* 2 mm diam, convex, hairy, pale brown overall. *Lamellae* all removed. *Stipe* 15  $\times$  0.5 mm, pubescent, pallid greyish brown, associated with fine, brown, wiry, glabrous rhizomorphs.

No lamellae are present on the extant basidiome. No basidiospores nor other hymenial cells observed; all degraded. *Pileipellis* of thick-walled hairs. *Hairs* 2.2–5.5(–6)  $\mu\text{m}$  diam., nearly all evenly sinuous, diam. equal, thick-walled (1–1.5  $\mu\text{m}$ ), apices cylindrical and obtuse, lacking secondary septations near apices, these scattered near base of hairs; hyaline to pale yellow, inamyloid to very weakly dextrinoid, non-incrusted. *Stipitipellis* setoid; acute-lanceolate, up to 11.5  $\mu\text{m}$  diam at broadest with walls up to 3.5  $\mu\text{m}$  thick, hyaline.



**Fig. 26.** 1. *Collybia multicolor* – a. Pileipellis hair. – 2. *Crinipellis carecomoeis* var. *subelata* – a. Pileipellis hairs b. Caulocystidia. – 3. *Crinipellis elata* – a. Pileipellis hairs b. Caulocystidia. – 4. *Crinipellis filiformis* – a. Basidiospores b. Pileipellis hair. – Bar: 1-4 = 10  $\mu$ m.

*Habitat:* On fallen leaves.

*Known distribution:* New Caledonia.

*Notes:* This epithet represents an insufficiently known species of *Crinipellis*. The protologue was based on dried material that was presumably nearly all used up during description. No intact lamellae are present so data on hymenial elements are unavailable. The species forms distinctive entirely sinuous pileus hairs and setoid caulocystidia.

*Status:* Insufficiently known.

**27. *Crinipellis elata*** Pat., Bull. Soc. Mycol. France 24: 167. 1908. (Fig. 26: 3)

= *Marasmius elatus* (Pat.) Sacc. & Trotter, Syllog. Fung. 21: 112. 1912.

= *Crinipellis carecomoeis* f. (monstr.) *elata* (Pat.) Singer, Lilloa 8: 489. 1942.

*Type:* NEW CALEDONIA, La Foa et la Col d' Amieu, 1907, coll. by Le Rat #96, on leaves (**Holotype:** FH!).

**Analysis of the holotype specimen**

The holotype specimen consists of two intact immature basidiomes in fair condition, plus two stipes, attached to a single dicot leaf. As dried: *Pileus* immature, < 1 mm diam, campanulate, silky-hairy, brown. *Lamellae* not observable. *Stipe* 45–170 × ≤ 0.5 mm, greyish brown, appressed-pubescent; *rhizomorphs* absent.

No hymenial elements were observable; pilei immature. *Pileipellis* of radially arranged, subparallel hairs. *Hairs* 2.5–4 µm diam., average about 3.2 µm diam., tips cylindrical, obtuse, thin-walled (≤ 0.5 µm), below the tip evenly sinuous for the rest of the length, thick-walled to solid (1–1.5 µm), hyaline to pale yellow, dextrinoid, smooth, non-incrusted. *Stipitipellis* of repent hairs; *hairs* cylindrical to sinuous, 2.2–4 µm diam. with walls up to 1.5 µm thick, similar to pileipellis hairs; lacking erect setoid lanceolate hairs.

*Habitat*: On leaves.

*Known distribution*: New Caledonia.

*Notes*: Singer (1942) considered *C. elata* as an abnormal sterile form of *C. carecomoeis* var. *subelata*, with a long stipe. He reported *C. elata* as growing on wood, but the holotype is clearly on a dicot leaf. *Crinipellis elata* is not contaxic with *C. carecomoeis* var. *subelata* as accepted by Singer. The latter taxon has erect, setoid, lanceolate hairs on the stipe that are lacking in *C. elata*.

*Status*: *Crinipellis elata* will remain insufficiently known until fertile specimens of this long-stiped taxon are found.

**28. *Crinipellis filiformis*** G. Stev., Kew Bull. 19: 42. 1964. (Fig. 26: 4)

*Type*: NEW ZEALAND, Buller Bush, 27 Oct. 1947, coll. by G. Stevenson Cone #213, under tawa (**Holotype**: K!).

**Analysis of the holotype specimen:**

The holotype specimen consists of one packet containing a leaf fragment with a few reddish brown, glabrous, wiry rhizomorphs; and a second packet containing one broken stipe plus one quarter of one pileus. As dried: *Pileus* 2 mm diam, disc with a small brown papilla, shaggy-hairy, cream-colored on the margin. *Lamellae* close, narrow, cream-colored. *Stipe* 8 × 0.5 mm, greyish brown, with cream-colored pubescence.

*Basidiospores* 8.3–10.5 × 4.2–5.2 µm [ $x_m = 9.1 \pm 0.7 \times 4.7 \pm 0.3$  µm,  $Q = 1.7$ –2.2,  $Q_m = 1.9 \pm 0$ ;  $n = 12$  spores per 1 collection], ellipsoid, smooth, hyaline, inamyloid, thin-walled. Hymenial elements not observable: no basidia, basidioles or cystidia seen. *Pileipellis* of tangled to subparallel and agglutinated, thick-walled hairs. *Hairs* > 300 × 2.2–3.5(–5.5) µm, cylindrical to sinuous, gradually narrowed to an acute or subacute tip, hyaline, inamyloid or dextrinoid; walls smooth, 0.5–1.3 µm thick; no secondary septa seen near the tips.

*Habitat*: Fallen leaves.

*Known distribution*: New Zealand.

*Notes*: Data on hymenial cells were not obtainable because of the poor quality of the limited material in the holotype specimen. Features of the cheilocystidia are required for accurate taxonomic placement.

*Status*: *Crinipellis filiformis* will remain an insufficiently known species of *Crinipellis* until more material becomes available for analysis.

**29. *Crinipellis novae-zelandiae*** G. Stev., Kew Bull. 19: 45. 1964.

≡ *Collybia novae-zelandiae* (G. Stev.) E. Horak, N. Zealand J. Bot. 9: 440. 1971.

≡ *Lentinula novae-zelandiae* (G. Stev.) Pegler, Sydowia 36: 234. 1983.

*Type*: NEW ZEALAND, Otari, Wilton's Bush, 18 May 1947, G. Stevenson Cone #150, on fallen logs (Holotype: K).

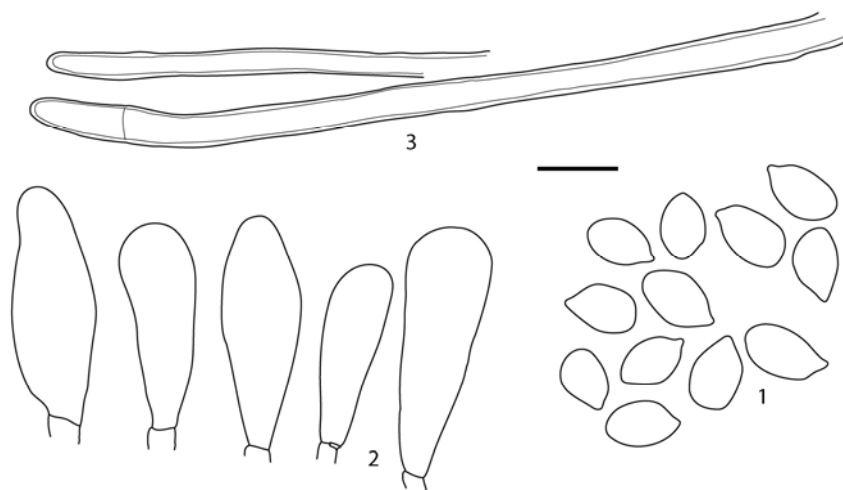
The holotype specimen consists of portions of the pilei of two basidiomes plus one broken stipe, in good condition. Material not examined.

*Notes*: Pegler (1983) provides a good description of this species and makes the formal transfer to *Lentinula* Earle. Hibbett *et al.* (1995) included New Zealand *Lentinula* isolates in their molecular phylogenetic analysis of shiitake mushrooms, and found that the NZ material, referable to *L. novae-zelandiae*, represents a monophyletic lineage, distinct from other *Lentinula* species.

*Status*: Currently accepted as *Lentinula novae-zelandiae*.

**30. *Crinipellis patouillardii*** Singer, Lilloa 8: 483. 1943. (Fig. 27: 1–3)

*Type*: JAPAN, Bonin Islands, 1.11.4, coll. by C. Wright, "on leaves in shaded ravine."



**Fig. 27.** *Crinipellis patouillardii* (Holotype). – 1. Basidiospores. – 2. Cheilocystidia. – 3. Pileipellis hairs. – Bar: 1-3 = 10  $\mu$ m.

U.S. North Pacific Exploring Expedition #25 as *Agaricus stipitarius* (**Holotype**: FH!).

**Analysis of the holotype specimen**

The holotype specimen consists of a mixed collection. Three basidiomes (one loose in the packet and two attached to woody sticks) represent the material described by Singer as *C. patouillardii*. Two additional basidiomes represent an agaric species in the Cortinariaceae. As dried, the holotype basidiomes as designated by Singer: *Pileus* 5 mm diam., convex with two concentric depressions surrounding a small papilla, radially shaggy-hairy, brown. *Lamellae* adnexed, subdistant, broad, pale brown. *Stipe* 7–8  $\times$  0.5–0.75 mm, shaggy-fibrillose, cream-beige, arising from woody (not leafy) substrate; *rhizomorphs* absent.

*Basidiospores* 7.7–10.2  $\times$  4.5–6 (–6.4)  $\mu$ m, [ $x_m = 8.9 \pm 0.8 \times 5.4 \pm 0.4 \mu$ m,  $Q = 1.4$ –1.9,  $Q_m = 1.7 \pm 0.1$ ;  $n = 20$  spores per 1 collection], broadly ellipsoid to subfusoid, smooth, hyaline, inamyloid, thick-walled. Basidia, basidioles and pleurocystidia collapsed; data unobtainable. *Cheilocystidia* agglutinated, many collapsed, common, 22–32  $\times$  7–10  $\mu$ m, clavate to broadly clavate, lacking diverticula or apical appendages, thick-walled, hyaline. *Pileipellis* of tangled to agglutinated and radially arranged hairs. *Hairs* > 200  $\times$  2.2–4  $\mu$ m (relatively narrow), single or in tufts of 5–10, cylindrical, not appreciably narrowed near the apex, obtuse, relatively thick-walled over the upper 30% (< 0.5  $\mu$ m), thick-walled at

the base (0.5–1.5  $\mu$ m), hyaline to pale brown, dextrinoid, non-incrusted, secondary septa rare. *Stipitipellis* similar to the pileipellis; *hairs* similar but with walls more evenly 1  $\mu$ m thick.

*Habitat*: On woody debris and leaves.

*Known distribution*: Japan.

*Notes*: This represents a good species of *Crinipellis*, distinctive because of the simple, broadly clavate cheilocystidia, relatively broad basidiospores, cylindrical and relatively narrow and thin-walled pileipellis hairs. Although Wright’s notes state “on leaves” the material in the holotype packet is on sticks. In addition, two non-*Crinipellis* cortinariaceous basidiomes are in the holotype packet.

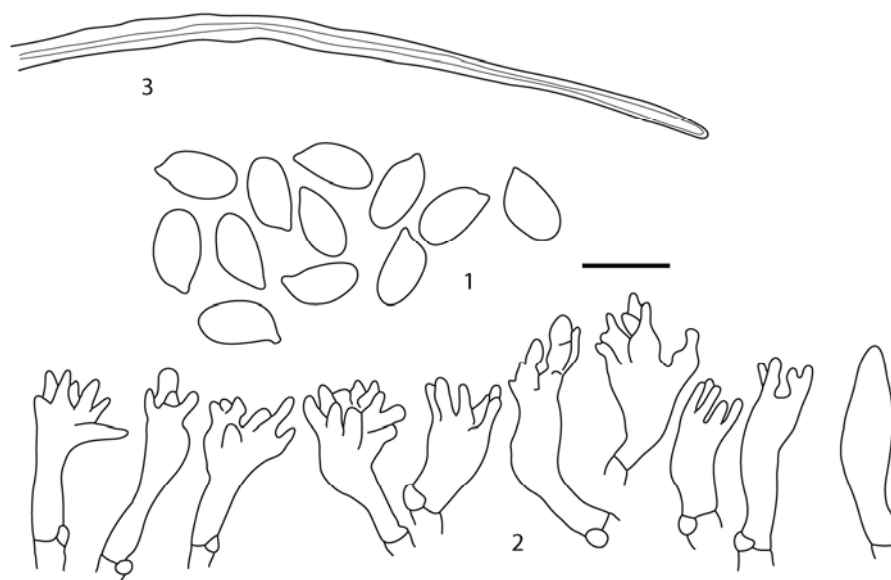
*Status*: *Crinipellis patouillardii* is known currently only from the Bonin Islands, Japan.

**31. *Crinipellis procera*** G. Stev., Kew Bull. 19: 43. 1964. (Fig. 28: 1–3)

*Type*: NEW ZEALAND, Levin, Ohau River, 22 July 1949, coll. by G. Stevenson Cone #743, inserted on dead twigs of forest litter (**Holotype**: K!).

*Analysis of the holotype specimen:*

The holotype specimen consists of 6 intact basidiomes in fair condition. As dried: *Pileus* 4–8 mm diam., conical with a conical papilla surrounded by a zone of long tufted hairs, margin with shorter and smaller tufts, yellowish brown to orangish brown. *Lamellae* free, close with 1 series of lamellulae, narrow, cream-colored. *Stipe* 60–100  $\times$  1 mm, pubescent, greyish brown; *rhizomorphs* absent.



**Fig. 28.** *Crinipellis procera* (Holotype). – 1. Basidiospores. – 2. Cheilocystidia. – 3. Pileipellis hair. – Bar: 1-3 = 10  $\mu$ m.

*Basidiospores* (7.7–) 8–9.6  $\times$  4.2–5.5  $\mu$ m [ $x_m$  = 8.8  $\pm$  0.5  $\times$  4.7  $\pm$  0.4  $\mu$ m,  $Q$  = 1.7–2.2,  $Q_m$  = 1.9  $\pm$  0.1,  $n$  = 20 spores per 1 collection], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 2- and 4-sterigmate, clavate, clamped. *Basidioles* subfusoid. *Pleurocystidia* absent. *Cheilocystidia* common, lamellar edge sterile; main body 11–20  $\times$  4.5–8  $\mu$ m, irregularly cylindrical to clavate with numerous apical appendages; apical appendages 1.5–6.5 (–10)  $\times$  1–3  $\mu$ m, finger-like or irregular in outline, obtuse, sometimes forked, hyaline, inamyloid, thin-walled. *Pileipellis* of tangled to parallel and agglutinated, thick-walled hairs. *Hairs* up to 700  $\mu$ m long  $\times$  2.5–4.5 (–5)  $\mu$ m diam., cylindrical, gradually narrowed to a subacute tip; walls smooth, 0.5–2  $\mu$ m thick, hyaline to yellow, inamyloid to dextrinoid. *Stipitipellis* with hairs like the pileipellis.

*Habitat*: Inserted on dead twigs of forest litter.

*Known distribution*: New Zealand.

*Notes*: This represents a good species of *Crinipellis* distinctive because of the conical-papillate, ochraceous pileus, long greyish brown stipe (up to 100 mm), setulose cheilocystidia, and the absence of rhizomorphs. It is allied with *C. setipes* (Peck) Singer from North America.

*Status*: *Crinipellis procera* is known currently only from New Zealand.

**32.** *Crinipellis readiae* G. Stev., Kew Bull. 19: 43. 1964 (as *Crinipellis readii*). (Fig. 29: 1)

$\equiv$  *Collybia stevensoniae* E. Horak, N. Zealand J. Bot. 9: 450. 1971 (as *C. stevensonii* comb. et nom. nov.), non *Collybia readiae* G. Stev., Kew Bull. 19: 9. 1964. Nom. illegit., a later homonym of *Collybia stevensonii* (Berk. & Broome) Sacc., Syllog. Fung. 5: 226. 1887.

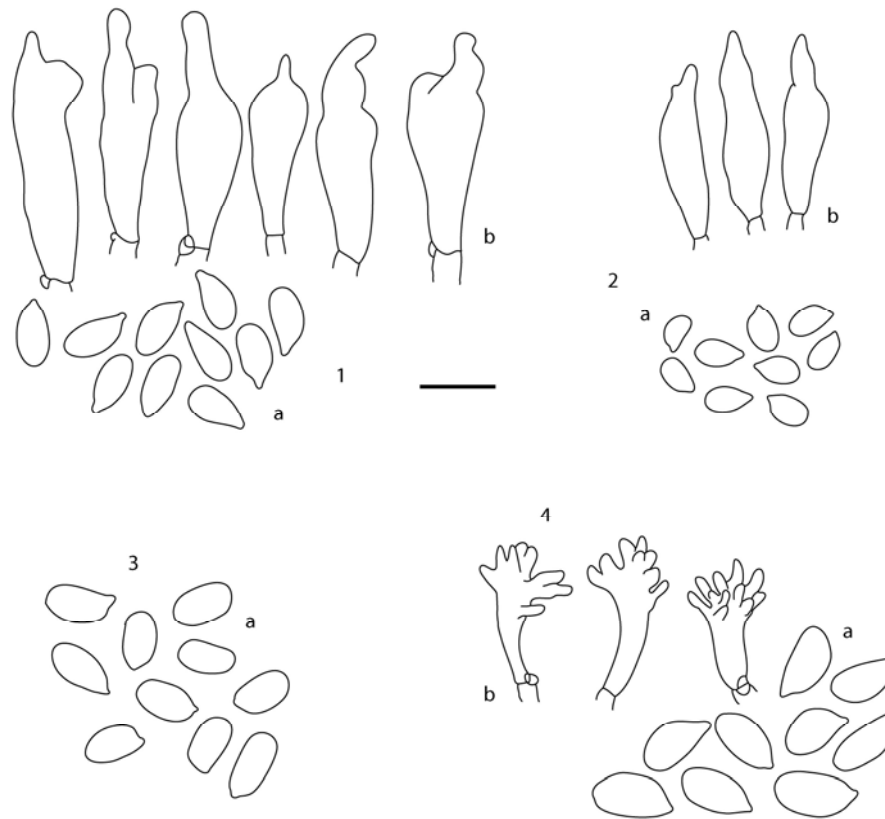
$\equiv$  *Gymnopus readiae* (G. Stev.) J.L. Mata, Sydowia 58: 289. 2007.

*Type*: NEW ZEALAND, Puramahoi, 20 April 1955, coll. by D. Reid, G. Stevenson Cone #985, in litter under *Leptospermum ericoides* (Holotype: K!).

#### *Analysis of the holotype specimen*

The holotype specimen consists of about 2 very fragmented basidiomes in fair condition. As dried: *Pileus* striate, pruinose overall, reddish brown. *Lamellae* adnexed, subdistant with 2 series of lamellulae, broad, cream-coloured. *Stipe* 1 mm diam, pubescent, yellowish grey-brown.

*Basidiospores* 8–9  $\times$  3.8–4.5  $\mu$ m [ $x_m$  = 8.5  $\pm$  0.3  $\times$  4.1  $\pm$  0.2  $\mu$ m,  $Q$  = 1.8–2.3,  $Q_m$  = 2.1  $\pm$  0.2,  $n$  = 10 spores per 1 collection], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* clavate, 4-spored, clamped. *Basidioles* clavate. *Pleurocystidia* absent. *Cheilocystidia* scattered, lamellar edge fertile; 22–40  $\times$  6.5–10  $\mu$ m, irregularly clavate to lageniform or ventricose, mucronate or forked, projections obtuse, hyaline, inamyloid, thin-walled. *Pileipellis* a cutis of repent, subparallel, cylindrical hyphae 3–5  $\mu$ m diam, non-



**Fig. 29.** 1. *Crinipellis readiae* – a. Basidiospores b. Cheilocystidia – 2. *Crinipellis roseola* – a. Basidiospores b. Cheilocystidia. – 3. *Crinipellis velutipes* – a. Basidiospores. – 4. *Crinipellis vinacea* – a. Basidiospores b. Cheilocystidia. – Bar: 1-4 = 10  $\mu$ m.

diverticulate, often with brown pigment incrustations.

*Notes:* Horak (1971: 450) transferred the species into *Collybia* as *C. stevensonii* because the name *Collybia readiae* was already taken. However, Horak was unaware that there was already a *Collybia stevensonii*, so his nom. nov. created an illegitimate homonym. Correcting the gender ending to the feminine “stevensoniae” for Stevenson’s species versus “stevensonii” for the Berkeley & Broome taxon does not legitimize the illegitimate homonym.

*Status:* This New Zealand species was transferred recently into *Gymnopus*. It does not represent a species of *Crinipellis*, but rather belongs in *Gymnopus* sect. *Vestipedes*.

**33. *Crinipellis roseola*** G. Stev., Kew Bull. 19: 42. 1964. (Fig. 29: 2)

*Type:* NEW ZEALAND, Arthur’s Pass, 7 June 1954, coll. by R. Mason, det. by G. Stevenson Cole #961, inserted on fallen dead leaves of *Nothofagus cliffortioides* (**Holotype:** K!).

#### *Analysis of the holotype specimen*

The holotype specimen consists of about 12 intact to fragmented basidiomes in fair condition. As dried: *Pileus* 1.5–2 mm diam., hemispherical, glabrous, pinkish orange. *Lamellae* adnate with a short tooth to arcuate or subdecurrent, subdistant, broad, pinkish orange, edges concolorous. *Stipe* 10–14  $\times$  0.5 mm, glabrous, orange, non-insititious, on leaves and small twigs.

*Basidiospores* 4.5–6.4  $\times$  2.8–3.8  $\mu$ m [ $x_m$  = 5.7  $\pm$  0.7  $\times$  3.4  $\pm$  0.3  $\mu$ m, Q = 1.4–1.8,  $Q_m$  = 1.7  $\pm$  0.1, n = 10 spores per 1 collection], ellipsoid to pip-shaped, smooth, hyaline, distinctly amyloid, thin-walled, mostly collapsed. *Basidia* clavate, 4-spored. *Basidioles* clavate. *Pleurocystidia* absent. *Cheilocystidia* scattered, edge heteromorphous; main body 22–25  $\times$  5.4–6.4  $\mu$ m, fusoid to irregular in outline, simple, hyaline, inamyloid, thin-walled. *Pileipellis* a cutis of repent hyphae with a few erect terminal cells; hyphae 1.5–2.5  $\mu$ m diam., cylindrical, smooth, hyaline,



inamyloid, mostly repent and agglutinated; terminal cells not differentiated, cylindrical, mostly repent. *Pileus* trama little differentiated, no distinct hypodermium; hyphae gelatinous, dextrinoid. *Stipe* cortical hyphae 2.2–4  $\mu\text{m}$  diam., parallel, cylindrical, smooth, non-gelatinous, hyaline, dextrinoid, clamped; medullary hyphae similar but up to 10  $\mu\text{m}$  diam.

*Habitat*: On fallen dead leaves.

*Known distribution*: New Zealand.

*Notes and Status*: The holotype specimen represents a small, pink species of *Mycena*. Until further material is collected to better diagnose the pileipellis anatomy, and until an accounting of previously described Australasian *Mycena* species is evaluated, a formal transfer will not be made.

**34. *Crinipellis substipitaria*** G. Stev., Kew Bull. 19: 43. 1964. (Fig. 30: 1–4)

*Type*: NEW ZEALAND, Levin, Lake Papaitonga, Buller Bush, 26 Oct. 1947, coll. by G. Stevenson Cone #211, on fallen dead leaves under tawa (**Holotype**: K!).

*Analysis of the holotype specimen*:

The holotype specimen consists of 5 intact or fragmented basidiomes in fair condition, one attached to a leaf. As dried: *Pileus* 3–4 mm diam., conical, radially fibrillose, pale brown. *Lamellae* subdistant to

close, broad, cream-colored. *Stipe* 10–25  $\times$  0.5 mm, shaggy, ochraceous; *rhizomorphs* absent. One *Mycena* basidiome is also in the collection.

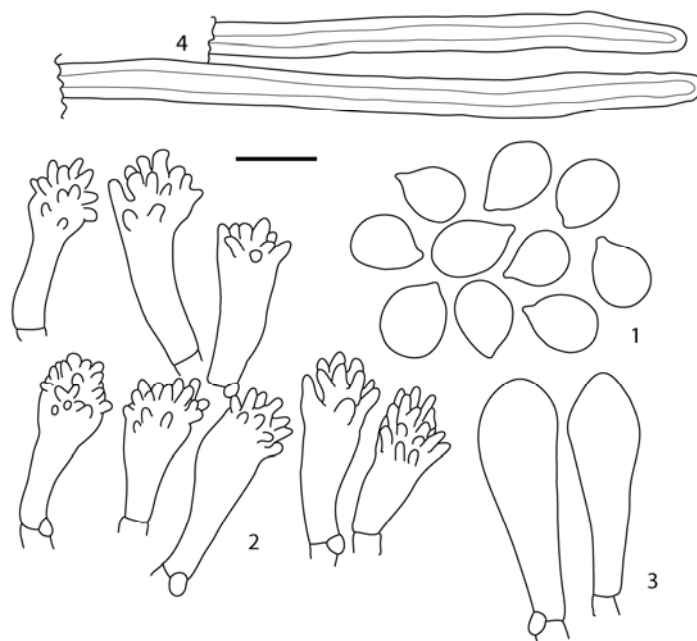
*Basidiospores* 8.6–10.5  $\times$  6.4–7.4 (–7.7)  $\mu\text{m}$ , [ $x_m = 9.5 \pm 0.7 \times 7.0 \pm 0.4 \mu\text{m}$ ,  $Q = 1.2$ – $1.5$ ,  $Q_m = 1.4 \pm 0.1$ ;  $n = 10$  spores per 1 collection], broadly ovoid, smooth, hyaline, inamyloid, thin- to firm-walled. *Basidia* clavate, clamped. *Basidioles* broadly fusoid. *Pleurocystidia* absent. *Cheilocystidia* common, lamellar edge heteromorphous; main body 14–23  $\times$  4.5–6.5  $\mu\text{m}$ , subcylindrical to clavate with numerous apical appendages; apical appendages 1.5–4  $\times$  1.2–1.5  $\mu\text{m}$ , rod-like, obtuse, seldom forked, hyaline, inamyloid, thin-walled. *Pileipellis* of tangled to subparallel, thick-walled hairs. *Hairs* > 300  $\times$  3.8–5  $\mu\text{m}$ , cylindrical to sinuous, narrowed near the apex to an obtuse tip, hyaline to yellowish brown, inamyloid to strongly dextrinoid; walls smooth, 0.5–2.5  $\mu\text{m}$  thick. *Stipitipellis* with hairs like the pileipellis.

*Habitat*: On fallen dead leaves.

*Known distribution*: New Zealand.

*Notes*: This represents a good species of *Crinipellis*, distinctive because of the very broad ovoid spores and the clavate-setulose cheilocystidia.

*Status*: *Crinipellis substipitaria* is known currently only from New Zealand.



**Fig. 30.** *Crinipellis substipitaria* (Holotype). – 1. Basidiospores. – 2. Cheilocystidia. – 3. Basidioles. – 4. Pileipellis hairs. – Bar: 1–4 = 10  $\mu\text{m}$ .

**35. *Crinipellis velutipes*** G. Stev., Kew Bull. 19: 45. 1964. (Fig. 29: 3)

*Type:* NEW ZEALAND, Waikanae, 1 Jan. 1951, G. Stevenson Cone #792, on fallen rotten log under *Dysoxylon spectabile* (**Holotype:** K!).

#### *Analysis of the holotype specimen*

The holotype specimen consists of about 5, large, fragmented basidiomes in fair condition, loose in the packet. As dried: *Pileus* up to 30 mm diam., plano-convex, striate, pellucid, pruinose, dark ferruginous. *Lamellae* adnexed, distant with 2–3 series of lamellulae, broad, concolorous with pileus. *Stipe* 22–40 × 2–3 mm, cleft, pubescent, mustard yellow-brown.

*Basidiospores* (6.5–) 7–9 × 4–5 μm [ $x_m = 7.9 \pm 0.6 \times 4.5 \pm 0.3 \mu\text{m}$ ,  $Q = 1.5\text{--}1.9$ ,  $Q_m = 1.7 \pm 0.1$ ,  $n = 20$  spores per 1 collection], subcylindrical to ellipsoid, smooth, hyaline, strongly amyloid, thin-walled. Other microdata not obtained.

*Habitat:* On fallen rotting log.

*Known distribution:* New Zealand.

*Notes:* Horak (1971: 459) indicated that the holotype specimen was sterile. This is not true. Basidiospores are very common and strongly amyloid. Subsequently, Horak (1979: 150) considered the species as a synonym of *Heimiomyces neovelutipes* (Hongo) E. Horak, a species based on *Collybia neovelutipes* Hongo, dating from 1974. Pegler (1977: 244) considered *C. velutipes* as a synonym of *Heimiomyces tenuipes* (Schwein.) Singer (as *Xeromphalina tenuipes*), but apparently did not examine the type collection of *C. velutipes*, and after Horak published his report, Pegler (1983: 248) removed *C. velutipes* from his list of synonyms. We agree that the old world, Australasian and Southeast Asian taxon is different from the New World *H. tenuipes* (as suggested by Horak 1979), and that *C. velutipes* (dating from 1964) may be conspecific with *H. neovelutipes*.

*Status:* If the above-stated premise is true, then the oldest epithet at species rank for this taxon is *velutipes*, and the correct name should be *Heimiomyces velutipes* (G. Stev.) comb. prov. (with *H. neovelutipes* as a synonym). Until further material of this species is collected from New Zealand and compared

with Papua New Guinea material (type locality of *H. neovelutipes*), a formal combination will not be made.

**36. *Crinipellis vinacea*** G. Stev., Kew Bull. 19: 44. 1964. (Fig. 29: 4)

≡ *Collybia vinacea* (G. Stev.) E. Horak, N. Zealand J. Bot. 9: 459. 1971.

*Type:* NEW ZEALAND, Nelson, Wakapuaka, Palmer's Bush, 14 April 1956, coll. by G. Stevenson Cone #1029, in litter on fallen rotting log (**Holotype:** K!).

#### *Analysis of the holotype specimen:*

The holotype specimen consists of two different species: About 10 basidiomes in total in fair condition, loose in the packet.

**Taxon 1:** As dried: *Pileus* 7–15 mm diam., plano-convex, striate, appressed-fibrillose, dark brown. *Lamellae* narrowly adnexed, subdistant with 2 series of lamellulae, narrow, greyish brown. *Stipe* up to 25 × 1 mm, pruinose, dark brown. *Cheilocystidia* simple, fusoid to clavate. *Pileipellis* a cutis of cylindrical hyphae with dark brown incrustations.

*Notes and Status:* This dark brown, possibly vinaceous, species is the one reported by Horak (1971: 459, Fig. 27:342) and may represent what Stevenson had in mind for *Crinipellis vinacea*. If the appropriate basidiomes could be separated, this taxon should be transferred as *Gymnopus vinacea* (G. Stevenson) comb. prov. and belongs in Sect. *Vestipedes*. A formal transfer will not be made here.

**Taxon 2:** As dried: *Pileus* 10–12 mm diam., plano-convex, non-striate or striatulate, glabrous, ochraceous. *Lamellae* adnexed, subdistant with 2 series of lamellulae, broad, cream- to clay-colored. *Stipe* 12–15 × 1 mm, glabrous, reddish brown. *Basidiospores* 9.3–11.2 × 4.8–5.7 μm [ $x_m = 10.3 \pm 0.7 \times 5.3 \pm 0.3 \mu\text{m}$ ,  $Q = 1.8\text{--}2.3$ ,  $Q_m = 2.0 \pm 0.1$ ,  $n = 10$  spores per 1 collection], elongate-ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Cheilocystidia* with main body 11–16 × 4–6.5 μm, subcylindrical to clavate with numerous apical diverticula; diverticula 1.5–5 × 1–2 μm, knob-like, hyaline, thin-walled. *Pileipellis* a *Dryophila*-structure of broad, short, branched cells with clavate terminal cells, hyaline or with brown plasmatic pigments.

*Notes and Status:* This second entity represents a species of *Gymnopus* (Pers.) Roussel in Sect. *Levipedes*. A formal transfer will not be made here.

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