

A monograph of *Marasmius* (Basidiomycota) from Northern Thailand based on morphological and molecular (ITS sequences) data

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Sixty-four taxa of *Marasmius* are reported representing fifty-seven species from northern Thailand. Comprehensive descriptions, illustrations, photographs, a dichotomous key to aid in their identification, and comparisons with phenetically similar taxa are provided. Seventeen species are described as new: *Marasmius araneocephalus*, *M. auratus*, *M. bondoi*, *M. brunneoolivascens*, *M. cafeyen*, *M. coarctatus*, *M. cupreostipes*, *M. delicatulus*, *M. ganyao*, *M. graminipes*, *M. imitarius*, *M. inthanonensis*, *M. jasminodorus*, *M. makok*, *M. pseudopellucidus*, *M. suthepensis* and *M. tantulus*. Molecular phylogenetic reconstructions are presented based on ITS regions in Bayesian, likelihood and parsimony analyses. Phylogenetic data were strongly correlated with morphological data and were useful to aid in delimiting species and distinguishing among closely related species. ITS sequences were of limited use, however, in recognizing currently circumscribed infrageneric taxa at the series rank and higher.

Key words: Agaricales, fungi, phylogeny, taxonomy

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Introduction

This paper is part of a series dealing with the macrofungi of northern Thailand (Le *et al.*, 2007a,b; Wannathes *et al.*, 2009). The genus *Marasmius* Fr. (Agaricales, Marasmiaceae) is worldwide in distribution and is composed of approximately 600 species. Recently *Marasmius* of Southeast Asia has received renewed interest through the research of Desjardin *et al.* (2000) in Indonesia, Tan *et al.* (2007) in Malaysia, and Desjardin *et al.* (2004) and Wannathes *et al.* (2004, 2007) in Thailand. To date, no monographic treatment of *Marasmius* has been published from Thailand. During the years 2003 to 2007, we conducted extensive fieldwork in three provinces (Chiang Mai, Chiang Rai and Phrae) of northern Thailand. As a result of these expeditions, we

present here a monograph of *Marasmius* from the region based on morphological and molecular (ITS sequences) data.

In this treatment we accept the generic circumscription of *Marasmius* as delimited by Wilson and Desjardin (2005). They restricted *Marasmius* to a monophyletic lineage based on nLSU rDNA sequences data including only sections *Globulares*, *Hygrometrici*, *Leveilleani*, *Marasmius*, *Neosessiles*, *Scotyphysini* and *Sicci* as defined by Singer (1976, 1986). Other sections recognized by Singer (1976, 1986) are currently excluded from *Marasmius*. Wilson and Desjardin (2005) transferred members of *Marasmius* section *Alliacei* to the genus *Mycetinis*. Section *Androsacei* was elevated to generic rank as *Setulipes* by Antonín (1987); section *Epiphylli* belongs in the family Physalacriaceae (Wilson and Desjardin 2005);

and section *Fusicystides* is treated as a synonym of *Setulipes* (Desjardin unpubl.).

Materials and methods

Morphological protocols

Color terms and notations in parentheses are those of Kornerup and Wanscher (1978). All measurements and colors reported for microscopic features were observed from dried material rehydrated in 100% ethanol followed by distilled water, 3% potassium hydroxide (KOH) or Melzer's reagent. The terms used to describe lamellae spacing refer to the number of lamellae that reach from the stipe to the pileus margin and do not include the lamellulae, whose spacing is indicated by the number of series present. Spore statistics include: \bar{x}_m , the arithmetic mean of the spore length by spore width (\pm standard deviation) for n spores measured in a single specimen; x_{mr} , the range of spore means, and x_{mm} , the mean of spore means (\pm SD) when more than one specimen is available; Q , the quotient of spore length by spore width in any one spore, 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_m values and Q_{mm} , the mean of Q_m values where more than one specimen is available; n , the number of spores measured per specimen; s , the number of specimens involved. Specimens are deposited in the mycological herbarium at Chiang Mai University (CMU), and the H. D. Thiers Herbarium at San Francisco State University (SFSU).

Phylogenetic protocols

Taxon sampling:

One hundred and twenty five Internal Transcribed Spacer (ITS) nrDNA sequences representing 62 species were used in the analyses, of which 116 sequences of *Marasmius* were generated as part of this study (Table 1), 4 sequences of *Marasmius* and 2 sequences of *Crinipellis* were obtained from Y.S. Tan (Univ. of Malaya), 2 sequences of *Marasmius* were obtained from GenBank, and 1 sequence of *Crinipellis* were obtained from J. Kerekes (San Francisco State Univ.). The sequences represent 59 species of *Marasmius* in nine traditionally accepted infrageneric

groups, and 3 species of *Crinipellis* for outgroup rooting purposes.

DNA extraction, Polymerase Chain Reaction and sequencing:

Genomic DNA was extracted from two sources: mostly from dried herbarium specimens, with fifteen extractions from living cultures (Table 1). Extraction of dried herbarium tissue (1-10 mg) was done using the E.Z.N.A. fungal DNA Miniprep Kit or E.Z.N.A. Forensic DNA Extraction Kit (Omega Bio-tek Inc., Norcross, GA, USA). Pure culture extractions were performed with a modified SDS extraction protocol of Roger and Bendich (1994) and Johnson (1998).

ITS regions 1 and 2, and the 5.8S rDNA, were amplified using primers ITS1-F, ITS5, ITS 4, ITS4-B (Gardes and Bruns, 1993; White *et al.*, 1990) and ITS4-m (TTG AGC TTT TCC CTC TTC AC) which was designed in this study. When the amplification failed the intermediate primers ITS2 and ITS3 (White *et al.*, 1990) were also used. The DNA fragment was amplified on GeneAmp PCR System 9600 (Applied Biosystems[®], Perkin-Elmer Corporation, Nottwalk, CT, USA) or PCT-100™ (MJ research, Inc., Watertown, MA, USA) automated thermal cycle. PCR products were purified using ExoSAPIT Kit (USB Corporation, Cleveland, OH, USA) or GFX™ PCR DNA or Gel band Purification Kit (Amersham Biosciences, USA) and run on an ABI 3100 Genetic Analyzer System (Applied Biosystems[®], Foster City, CA, USA). Sequence editing was performed with Sequencher 4.2 software (GeneCodes Co., Ann Arbor, MI, USA). Edited sequences have been deposited in GenBank (Table 1).

Phylogenetic analyses:

Initial sequence alignment was performed with Clustal X (Thompson *et al.*, 1997) using the default settings, followed by manual alignment with MacClade 4.04 (Maddison and Maddison, 2001). Parsimony analyses were conducted using PAUP* 4.0b10 (Swofford, 2002). Searches employed a heuristic search method with all characters weighted equally, gaps treated as missing data, random stepwise sequence addition, tree bisection reconnection (TBR), and collapse of

Table 1. List of *Marasmius* specimens sequenced (ITS1-5.8S-ITS2) for this study, itemized by infrageneric group.

Species	Sections/ Series	Collection No.	GenBank accession No.
<i>M. albimyceliosus</i>	<i>Globulares</i>	NW422	EU935544
<i>M. calvus</i>	<i>Globulares</i>	NW331	EU935481
<i>M. grandiviridis</i>	<i>Globulares</i>	NW152	EU643514
<i>M. grandiviridis</i>	<i>Globulares</i>	NW349**	EU643515
<i>M. laticlavatus</i>	<i>Globulares</i>	NW231	EU643510
<i>M. laticlavatus</i>	<i>Globulares</i>	NW293	EU643512
<i>M. laticlavatus</i>	<i>Globulares</i>	NW412	EU643511
<i>M. mokfaensis</i>	<i>Globulares</i>	DED7726	EU643516
<i>M. mokfaensis</i>	<i>Globulares</i>	NW020**	EU643517
<i>M. pellucidus</i>	<i>Globulares</i>	NW321	EU935508
<i>M. pellucidus</i>	<i>Globulares</i>	NW342	EU935509
<i>M. pellucidus</i>	<i>Globulares</i>	NW352	EU935510
<i>M. purpureostriatus</i>	<i>Globulares</i>	NW158	EU935539
<i>M. purpureostriatus</i>	<i>Globulares</i>	NW318	EU935538
<i>M. pseudopurpureostriatus</i>	<i>Globulares</i>	NW286	EU643513
<i>M. leveilleanus</i>	<i>Leveilleani</i>	NW248	EU935566
<i>M. leveilleanus</i>	<i>Leveilleani</i>	NW268	EU935567
<i>M. apatelius</i>	<i>Marasmius/ Marasmius</i>	NW427	EU935561
<i>M. apatelius</i>	<i>Marasmius/ Marasmius</i>	NW437**	EU935562
<i>M. somalomoensis</i>	<i>Marasmius/ Marasmius</i>	NW232	EU935559
<i>M. tantulus</i>	<i>Marasmius/ Marasmius</i>	NW239	EU935560
<i>M. brevicollus</i>	<i>Marasmius/ Sicciformes</i>	NW128	EU935558
<i>M. cafeyen</i>	<i>Marasmius/ Sicciformes</i>	NW058**	EU935546
<i>M. cafeyen</i>	<i>Marasmius/ Sicciformes</i>	NW130***	EU935547
<i>M. cafeyen</i>	<i>Marasmius/ Sicciformes</i>	NW200*	EU935548
<i>M. crinis-equi</i>	<i>Marasmius/ Sicciformes</i>	NW348	EU935555
<i>M. aff. crinis-equi</i>	<i>Marasmius/ Sicciformes</i>	NW182	EU935564
<i>M. aff. crinis-equi</i>	<i>Marasmius/ Sicciformes</i>	NW205	EU935565
<i>M. guyanensis</i>	<i>Marasmius/ Sicciformes</i>	NW254*	EU935552
<i>M. guyanensis</i>	<i>Marasmius/ Sicciformes</i>	NW280*	EU935553
<i>M. guyanensis</i>	<i>Marasmius/ Sicciformes</i>	TYS314*	EU935554
<i>M. nigrobrunneus</i>	<i>Marasmius/ Sicciformes</i>	NW162	EU935570
<i>M. nigrobrunneus</i>	<i>Marasmius/ Sicciformes</i>	NW223	EU935572
<i>M. nigrobrunneus</i>	<i>Marasmius/ Sicciformes</i>	NW416*	EU935571
<i>M. nigrobrunneus</i> “f. <i>cinnamomeus</i> ”	<i>Marasmius/ Sicciformes</i>	NW025	EU935576
<i>M. nigrobrunneus</i> “f. <i>cinnamomeus</i> ”	<i>Marasmius/ Sicciformes</i>	NW119	EU935573
<i>M. nigrobrunneus</i> “f. <i>cinnamomeus</i> ”	<i>Marasmius/ Sicciformes</i>	NW120	EU935578
<i>M. nigrobrunneus</i> “f. <i>cinnamomeus</i> ”	<i>Marasmius/ Sicciformes</i>	NW260*	EU935574
<i>M. nigrobrunneus</i> “f. <i>cinnamomeus</i> ”	<i>Marasmius/ Sicciformes</i>	NW327*	EU935577
<i>M. nigrobrunneus</i> “f. <i>cinnamomeus</i> ”	<i>Marasmius/ Sicciformes</i>	TYS281	EU935575
<i>M. purpureobrunneolus</i>	<i>Marasmius/ Sicciformes</i>	NW215*	EU935556
<i>M. purpureobrunneolus</i>	<i>Marasmius/ Sicciformes</i>	NW370	EU935557
<i>M. purpureisetosus</i>	<i>Marasmius/ Sicciformes</i>	NW155	EU935563
<i>M. ruforotula</i>	<i>Marasmius/ Sicciformes</i>	NW257*	EU935550
<i>M. ruforotula</i>	<i>Marasmius/ Sicciformes</i>	NW312	EU935551
<i>M. straminiceps</i>	<i>Marasmius/ Sicciformes</i>	NW256	EU935549
<i>M. subruforotula</i>	<i>Marasmius/ Sicciformes</i>	NW140	EU935579
<i>M. tenuissimus</i>	<i>Neosessiles</i>	NW192*	EU935568
<i>M. tenuissimus</i>	<i>Neosessiles</i>	NW199	EU935569
<i>M. araucariae</i> var. <i>siccipes</i>	<i>Sicci/ Atrorubentes</i>	NW364	EU935511
<i>M. auratus</i>	<i>Sicci/ Atrorubentes</i>	NW076	EU935501
<i>M. auratus</i>	<i>Sicci/ Atrorubentes</i>	NW175	EU935502

*genomic DNA extracted from pure cultures, ** only ITS1-5.8S sequences were generated, *** only 5.8S-ITS2 sequences were generated

Table 1 (Continued). List of *Marasmius* specimens sequenced (ITS1-5.8S-ITS2) for this study, itemized by infrageneric group.

Species	Sections/ Series	Collection No.	GenBank accession No.
<i>M. inthanonensis</i>	<i>Sicci/ Atrorubentes</i>	NW414	EU935515
<i>M. iras</i>	<i>Sicci/ Atrorubentes</i>	NW276	EU935486
<i>M. iras</i>	<i>Sicci/ Atrorubentes</i>	NW375	EU935487
<i>M. jasminodorus</i>	<i>Sicci/ Atrorubentes</i>	NW067**	EU935512
<i>M. jasminodorus</i>	<i>Sicci/ Atrorubentes</i>	NW294	EU935513
<i>M. jasminodorus</i>	<i>Sicci/ Atrorubentes</i>	NW353	EU935514
<i>M. luteolus</i>	<i>Sicci/ Atrorubentes</i>	NW138	EU935506
<i>M. luteolus</i>	<i>Sicci/ Atrorubentes</i>	NW304	EU935507
<i>M. ochroleucus</i>	<i>Sicci/ Atrorubentes</i>	NW299	EU935503
<i>M. pseudopellucidus</i>	<i>Sicci/ Atrorubentes</i>	NW186	EU935504
<i>M. pseudopellucidus</i>	<i>Sicci/ Atrorubentes</i>	NW305	EU935505
<i>M. xestocephalus</i>	<i>Sicci/ Atrorubentes</i>	JFK69	EU935488
<i>M. xestocephalus</i>	<i>Sicci/ Atrorubentes</i>	NW344	EU935489
<i>M. bambusiniiformis</i>	<i>Sicci/ Leonini</i>	NW329	EU935521
<i>M. bambusiniiformis</i>	<i>Sicci/ Leonini</i>	NW368	EU935522
<i>M. bambusiniiformis</i>	<i>Sicci/ Leonini</i>	NW410	EU935523
<i>M. corneri</i>	<i>Sicci/ Leonini</i>	NW269	EU935482
<i>M. corneri</i>	<i>Sicci/ Leonini</i>	TYS274*	EU935483
<i>M. cremeus</i>	<i>Sicci/ Leonini</i>	WN366	EU935494
<i>M. cremeus</i>	<i>Sicci/ Leonini</i>	TYS320	EU935495
<i>M. cupreostipes</i>	<i>Sicci/ Leonini</i>	NW150	EU935485
<i>M. imitarius</i>	<i>Sicci/ Leonini</i>	NW297	EU935496
<i>M. imitarius</i>	<i>Sicci/ Leonini</i>	NW423	EU935497
<i>M. imitarius</i>	<i>Sicci/ Leonini</i>	NW425	EU935498
<i>M. makok</i>	<i>Sicci/ Leonini</i>	NW201	EU935524
<i>M. bondoi</i>	<i>Sicci/ Haematocephali</i>	NW011	EU935472
<i>M. bondoi</i>	<i>Sicci/ Haematocephali</i>	NW237	EU935473
<i>M. bondoi</i>	<i>Sicci/ Haematocephali</i>	NW320	EU935474
<i>M. bondoi</i>	<i>Sicci/ Haematocephali</i>	NW384	EU935475
<i>M. bondoi</i>	<i>Sicci/ Haematocephali</i>	NW386	EU935476
<i>M. bondoi</i>	<i>Sicci/ Haematocephali</i>	NW390	EU935477
<i>M. bondoi</i>	<i>Sicci/ Haematocephali</i>	NW399	EU935478
<i>M. brunneoolivascens</i>	<i>Sicci/ Haematocephali</i>	NW112	EU935516
<i>M. brunneoolivascens</i>	<i>Sicci/ Haematocephali</i>	NW277**	EU935519
<i>M. brunneoolivascens</i>	<i>Sicci/ Haematocephali</i>	NW373	EU935517
<i>M. brunneoolivascens</i>	<i>Sicci/ Haematocephali</i>	NW397***	EU935518
<i>M. ganyao</i>	<i>Sicci/ Haematocephali</i>	NW005	EU935499
<i>M. graminipes</i>	<i>Sicci/ Haematocephali</i>	NW078	EU935479
<i>M. haematocephalus</i> “f. <i>atrobrunneus</i> ”	<i>Sicci/ Haematocephali</i>	NW117	EU935525
<i>M. haematocephalus</i> “f. <i>violaceus</i> ”	<i>Sicci/ Haematocephali</i>	NW193*	EU935531
<i>M. haematocephalus</i> “f. <i>violaceus</i> ”	<i>Sicci/ Haematocephali</i>	NW339	EU935532
<i>M. haematocephalus</i> “f. <i>violaceus</i> ”	<i>Sicci/ Haematocephali</i>	NW413	EU935533
<i>M. haematocephalus</i> f. <i>haematocephalus</i>	<i>Sicci/ Haematocephali</i>	NW296	EU935526
<i>M. haematocephalus</i> f. <i>haematocephalus</i>	<i>Sicci/ Haematocephali</i>	NW409	EU935527
<i>M. haematocephalus</i> f. <i>haematocephalus</i>	<i>Sicci/ Haematocephali</i>	NW428	EU935528
<i>M. haematocephalus</i> f. <i>haematocephalus</i>	<i>Sicci/ Haematocephali</i>	NW434	EU935529
<i>M. haematocephalus</i> f. <i>haematocephalus</i>	<i>Sicci/ Haematocephali</i>	TYS277	EU935530
<i>M. haematocephalus</i> “f. <i>luteocephalus</i> ”	<i>Sicci/ Haematocephali</i>	NW310	EU935534
<i>M. haematocephalus</i> “f. <i>robustus</i> ”	<i>Sicci/ Haematocephali</i>	NW330	EU935537
<i>M. haematocephalus</i> “f. <i>robustus</i> ”	<i>Sicci/ Haematocephali</i>	NW433	EU935536
<i>M. haematocephalus</i> “f. <i>variabilis</i> ”	<i>Sicci/ Haematocephali</i>	NW430	EU935535
<i>M. hypophaeus</i>	<i>Sicci/ Haematocephali</i>	NW285	EU935484
<i>M. aff. pallescens</i>	<i>Sicci/ Haematocephali</i>	NW424	EU935500
<i>M. suthepensis</i>	<i>Sicci/ Haematocephali</i>	TYS280*	EU935520

*genomic DNA extracted from pure cultures, ** only ITS1-5.8S sequences were generated, *** only 5.8S-ITS2 sequences were generated

Table 1 (Continued). List of *Marasmius* specimens sequenced (ITS1-5.8S-ITS2) for this study, itemized by infrageneric group.

Species	Sections/ Series	Collection No.	GenBank accession No.
<i>M. araneocephalus</i>	<i>Sicci/ Spinulosi</i>	NW358	EU935540
<i>M. coarctatus</i>	<i>Sicci/ Spinulosi</i>	NW315	EU935541
<i>M. coarctatus</i>	<i>Sicci/ Spinulosi</i>	NW385	EU935542
<i>M. coklatus</i>	<i>Sicci/ Spinulosi</i>	TYS301	EU935543
<i>M. nummularius</i>	<i>Sicci/ Spinulosi</i>	NW266	EU935492
<i>M. nummularius</i>	<i>Sicci/ Spinulosi</i>	NW396	EU935493
<i>M. trichotus</i>	<i>Sicci/ Spinulosi</i>	NW262*	EU935490
<i>M. trichotus</i>	<i>Sicci/ Spinulosi</i>	NW263*	EU935491

*genomic DNA extracted from pure cultures, ** only ITS1-5.8S sequences were generated, *** only 5.8S-ITS2 sequences were generated

zero length branches. Analyses were performed in two steps: first, 1000 random sequence addition replicates were performed, saving no more than 5 trees per replicate, with MaxTrees set to auto increase. Second, with MaxTrees reset to 15 K, the most parsimonious trees resulting from the first step were used as starting trees and the analysis was allowed to swap to completion.

The appropriate model of sequence evolution for phylogenetic analyses was determined using the program MrModeltest v2.3 (Nylander, 2004). Maximum likelihood (ML) analyses were conducted in PAUP*, and employed the GTR+I+G model of sequence evolution. ML searches followed an iterative search strategy. First, a neighbor joining (NJ) tree was constructed using a Jukes-Cantor (JC) distance model. Next, with the search criterion reset to ML, the model parameters were estimated from the NJ tree, fixed, and an ML search was conducted. After this initial search was completed, the model parameters were re-estimated from the resulting ML tree(s), fixed, and another ML search was initiated with starting trees obtained via NJ. This step was completed a third and final time, for a total of three independent ML searches. Upon completion of the final search, trees resulting from all three iterations were compared to insure that the searches had converged on equally likely topologies. Maximum likelihood bootstrapping was performed in GARLI v0.951 (Zwickl, 2006) with 300 replicates under the GTR+I+G model of sequence evolution, with all parameter values estimated by the program and using the default run termination settings.

Bayesian phylogenetic analyses were carried out using Metropolis-coupled Markov chain Monte Carlo (MCMCMC) methods with MrBayes v3.1.2 (Huelsenbeck & Ronquist, 2001; Ronquist and Huelsenbeck, 2003), under a GTR+I+G model as determined above. The analyses consisted of two parallel searches, run for 5,000,000 generations, with six chains and random starting trees. Default settings in MrBayes were used for the incremental heating scheme of the chains (3 heated and 1 cold chain), unconstrained branch length (unconstrained: exponential (10.0)), and uninformative topology (uniform) priors. The chains were sampled every 1000 generations. Trees sampled prior to searches reaching a split deviation frequency of 0.03 were discarded as the burn-in, and the resulting trees were used to calculate Bayesian posterior probabilities.

To further analyze the relationships among three *Marasmius* species complexes, sub-alignments were constructed by pruning taxa from the larger ITS dataset to represent the species complexes and sister taxa. Bootstrap analyses were performed in PAUP* on resulting sub-alignments, consisting of 2000 replicates under a branch and bound search algorithm with furthest sequence addition and MulTrees on.

Results

Molecular Phylogeny

Phylogenetic analyses were performed on an ITS dataset of 125 sequences of which 112 sequences were *Marasmius* species and 3 sequences were *Crinipellis* species, with the

latter used as an outgroup for rooting purposes. Two new Thai *Marasmius* species were not included in the analyses because of the presence of multiple different ITS copies in each species. Cloning was not conducted to address this problem. Sequencing products ranged from 270 nucleotides (*Marasmius mokfaensis* NW020; partial sequence) to 883 nucleotides (*Marasmius tantulus* NW239). All sequences were aligned and the ends trimmed to create a dataset of 701 nucleotides that included 354 parsimony informative characters.

Each of the ML analysis iterations recovered a single tree, the likelihood values of which did not differ significantly. We have selected the topology resulting from the third iteration to present here (Fig. 1; -lnL = 10983.475). Parsimony analyses produced 15 K equally parsimonious trees (819 steps, C.I. = 0.427, R.I. = 0.701), which did not differ significantly in topology from those recovered in the ML analyses. Bayesian analyses reached a standard deviation of split frequencies of 0.03 after 1,592,000 generations, and the initial 4000 trees recovered were excluded as the burn-in. Maximum likelihood bootstrap values (BS) and Bayesian posterior probabilities (PP) support many of the terminal nodes in the phylogeny, but fail to recover the deeper nodes with strong support.

All members of sections *Globulares* plus *Sicci* belong to a monophyletic clade with relatively strong support (1.0 PP and 76% BS; clade A), although the sections themselves are not monophyletic. Eight species currently placed in sect. *Globulares* fall into three distinct subclades (AA, AD, AF), although five of them belong to a single subclade (AD) but with low support (.67 PP, 52% BS). Members of section *Marasmius*, comprised of species with lamellae attached to a collarium, do not form a monophyletic group (clades B-F and other species at the base of the tree). Section *Marasmius* subsection *Marasmius* (collariate species with *Rotalis*-type broom cells) is monophyletic for the four included species with 1.0 PP and 83% BS support (clade D).

Section *Marasmius* subsection *Sicciformes* (collariate species with *Siccus*-type broom cells) is not monophyletic, with species clustering into more than three separate clades: clade B with 0.91 PP and 60% BS; clade C with 0.92 PP and 85 % BS; clade E with no statistical support; plus four unsupported taxa at the base of the tree. A single member of section *Neosessiles* (*M. tenuissimus*) and the monotypic section *Leveilleani* (*M. leveilleanus*) form a clade (F) with relatively strong support (0.97 PP and 82% BS) although its placement in the tree is not supported statistically. Within sect. *Sicci*, the four infrasectional taxa circumscribed by Singer (1976) based on micromorphological features (viz., series *Atrorubentes*, *Haematocephali*, *Leonini*, *Spinulosi*) are not monophyletic (Fig. 1). Members of ser. *Atrorubentes* fall into two clades (AA, AC); members of ser. *Haematocephali* belong to three clades (AA, AB, AE) and two isolated lineages; members of ser. *Leonini* are scattered throughout Clade A; while members of ser. *Spinulosi* fall into two clades (AC, AF) plus an isolated lineage sister to AA (*M. coarctatus*). Clade AF, with 1.0 PP support, contains members of sect. *Globulares*, sect. *Sicci* series *Leonini* and *Spinulosi*.

In the ML analysis, three species complexes were uncovered, based on *M. bondoi* (sect. *Sicci* ser. *Haematocephali*; clade AB) with 1.0 PP and 74% BS support, *M. haematocephalus* (sect. *Sicci* ser. *Haematocephali*; clade AE) with 1.0 PP and 99% BS support, and *M. nigrobrunneus* (sect. *Marasmius* subsect. *Sicciformes*) in an unresolved position near the base of the tree (Fig. 1). To help clarify the taxonomic boundaries of these species complexes, three separate bootstrap branch and bound analyses were performed based on datasets that included the ingroup taxa with their sister taxa (as resolved in the ML tree) used as outgroup. These results will be discussed in the commentaries that follow the species descriptions.

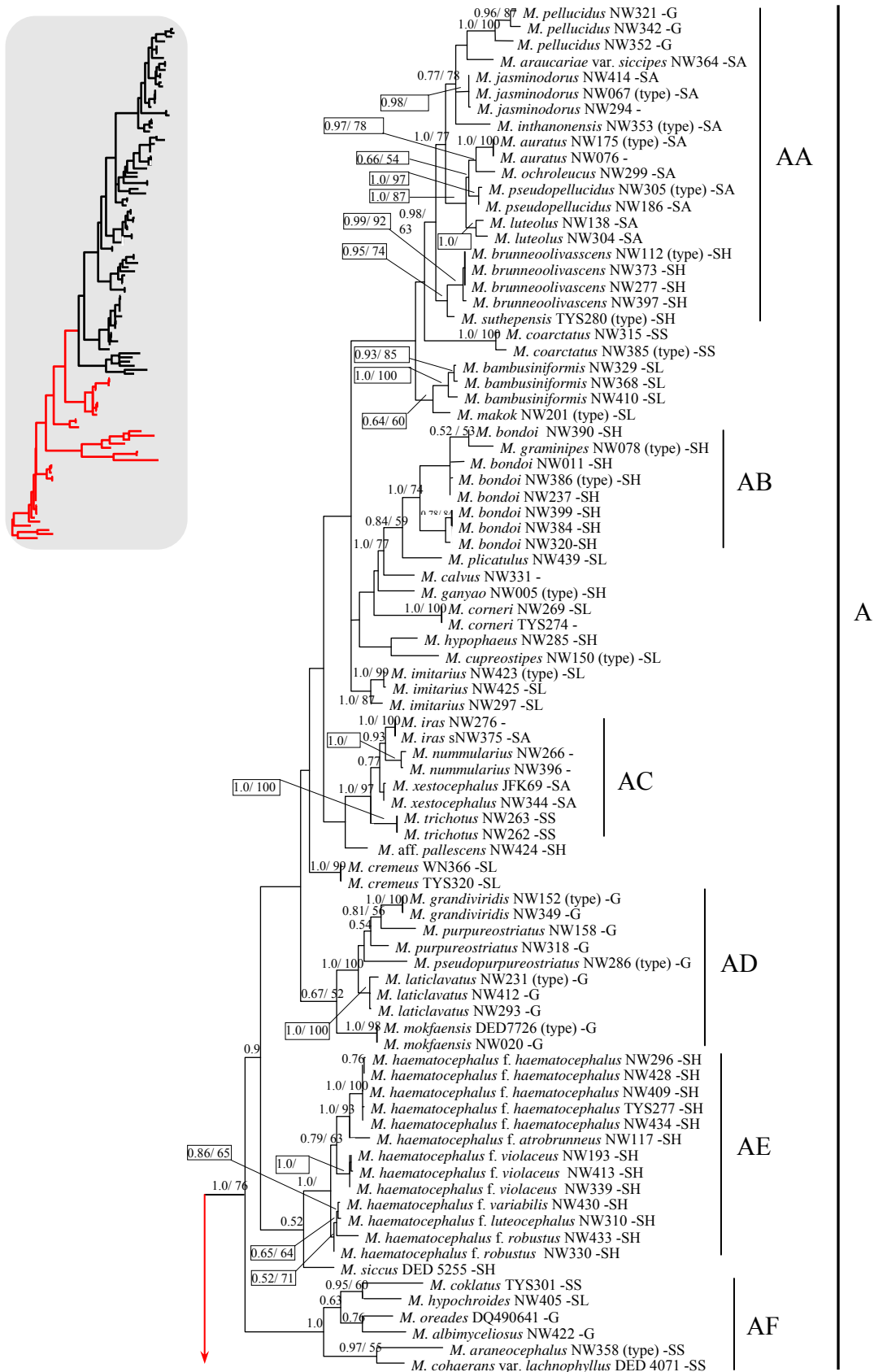


Fig. 1. Maximum likelihood tree (-lnL = 10983.745) generated using a GTR+I+G model of nucleotide evolution. Numbers to the left of / are Bayesian posterior probabilities, and those to the right are ML bootstrap percentages. G – sect. *Globulares*; L – sect. *Leveilleani*; MM – sect. *Marasmius* subsect. *Marasmius*; MS – sect. *Marasmius* subsect. *Sicciformes*; N – sect. *Neosessiles*; SA – sect. *Sicci* ser. *Atrorubentes*; SH – sect. *Sicci* ser. *Haematocephali*; SL – sect. *Sicci* ser. *Leonini*; SS – sect. *Sicci* ser. *Spinulosi*.

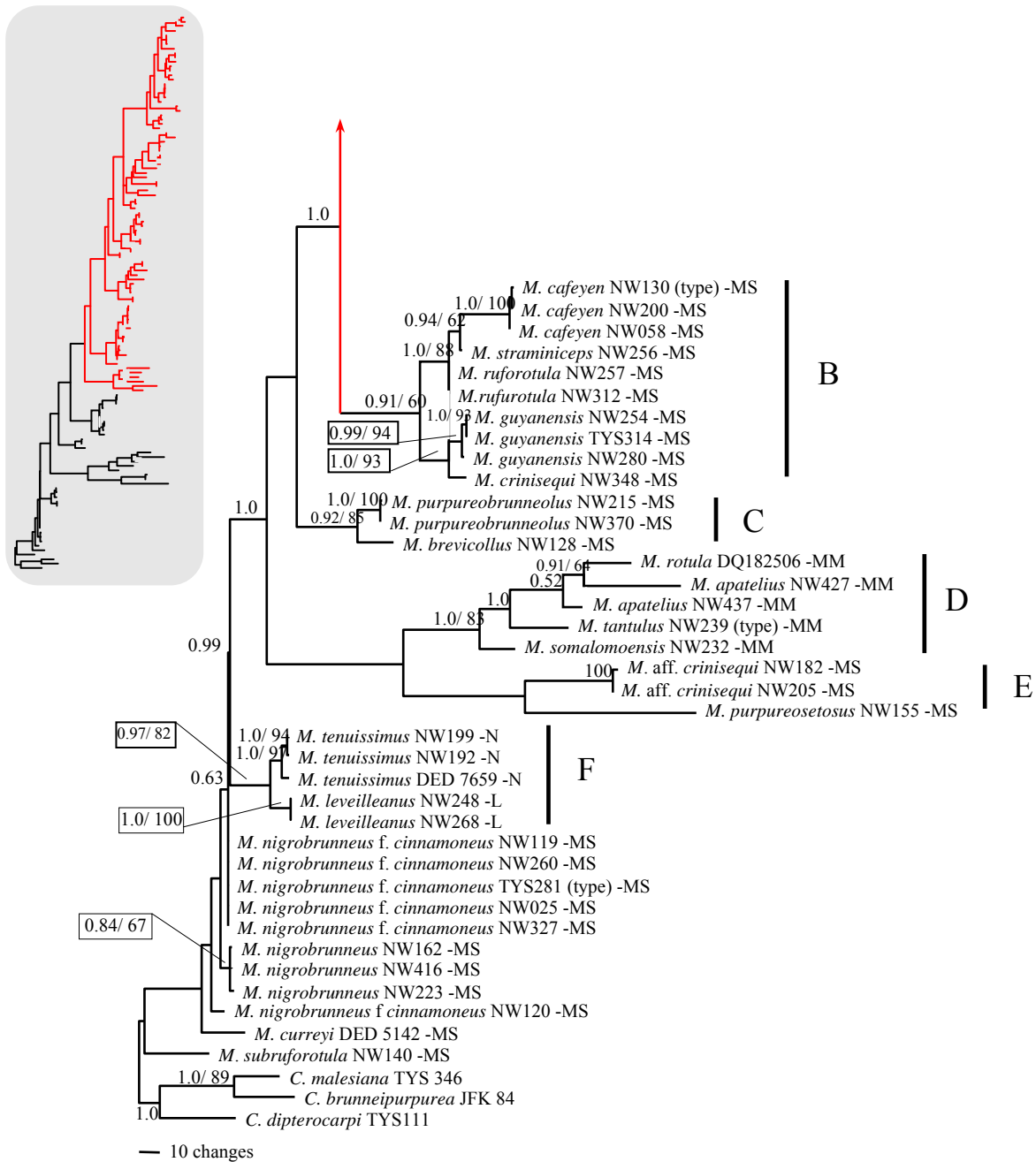


Fig. 1 (Continued). Maximum likelihood tree (-lnL = 10983.745) generated using a GTR+I+G model of nucleotide evolution. Numbers to the left of / are Bayesian posterior probabilities, and those to the right are ML bootstrap percentages. G – sect. *Globulares*; L – sect. *Leveilleani*; MM – sect. *Marasmius* subsect. *Marasmius*; MS – sect. *Marasmius* subsect. *Sicciformes*; N – sect. *Neosessiles*; SA – sect. *Sicci* ser. *Atrorubentes*; SH – sect. *Sicci* ser. *Haematocephali*; SL – sect. *Sicci* ser. *Leonini*; SS – sect. *Sicci* ser. *Spiculosi*.

Taxonomy

Key to species of *Marasmius* from northern Thailand

1. Collarium present; stipe insititious..... (sect. *Marasmius*) **2**
1. Collarium absent; stipe insititious or non-insititious **21**
2. Pileipellis composed of *Rotalis*-type broom cells (subject. *Marasmius*) **3**
2. Pileipellis composed of *Siccus*-type broom cells..... (subject. *Sicciformes*) **6**
3. Basidiospores (17-) 20-22 × 4 µm; basidiomes very small, with pilei up to 1.5 mm diam and stipes up to 1 mm long..... **1. M. tantulus**
3. Basidiospores ≤ 15 µm long; basidiomes larger, with pilei usually > 1.5 mm diam and stipes > 5 mm long..... **4**
4. Lamellae distant (6-10), non-marginate; pileus yellowish white to brownish cream with a light brown central spot **2. M. delicatulus**
4. Lamellae subdistant to close (9-18), brown-marginate; pileus brown with a hint of olive or brownish cream to yellowish brown..... **5**
5. Pileus 2-4 mm diam, brown with a hint of olive, with a reddish brown papilla in the center surround by a pale zone; stipe 8-47 mm long **3. M. somalomoensis**
5. Pileus 2-10 mm diam, light brownish cream to yellowish brown without olive tones, with or without a small brown papilla, lacking a pale central zone; stipe 8-15 mm long **4. M. apatelius**
6. Pileus minutely hispidulous from the presence of pileosetae..... **7**
6. Pileus glabrous, lacking pileosetae..... **8**
7. Pileosetae uncommon, 36-82 µm long; pileipellis broom cells and cheilocystidia with numerous (5-20) apical setulae; lamellae distant (7-8); pileus 0.2-2 mm diam; stipe arising directly from rhizomorphs... .. **5. M. berambutanus**
7. Pileosetae common, 45-350 µm long; pileipellis broom cells and cheilocystidia with few (2-6) apical setulae; lamellae subdistant (13-17); pileus 1-4 mm diam; stipe not arising directly from rhizomorphs..... **6. M. purpureisetosus**
8. Basidiospores > 13 µm long..... **9**
8. Basidiospores ≤ 12 µm long..... **10**
9. Basidiospores 16-23 × 3.5-5.5 µm, $x_{mm} = 19.7 \times 4.6 \mu\text{m}$; lamellae distant (6-9) **7. M. brevicollis**
9. Basidiospores 13-16 × 3-4 µm, $x_{mm} = 14.2 \times 3.2 \mu\text{m}$; lamellae distant to subdistant (9-13)..... **8. M. purpureobrunneolus**
10. Stipe arising directly from rhizomorphs..... **11**
10. Stipe arising directly from the substrate; rhizomorphs present or absent..... **16**
11. Basidiomes and rhizomorphs associated with wood; lamellae remote to distant (5-10) **12**
11. Basidiomes and rhizomorphs associated with leaves, typically bamboo and other grasses or rarely dicot leaves; lamellae subdistant (8-17) **14**
12. Pileus very pale, cream-colored. **9. M. pallenticeps**
12. Pileus more deeply pigmented, reddish brown to orangish brown, orange to greyish orange **13**
13. Pileus reddish brown to orangish brown; lamellae distant (8-10); basidiospores 10-12 × 4-4.5 µm, $x_{mm} = 10.6 \times 4.6 \mu\text{m}$, $Q_m = 2$ **10. M. crinis-equi**
13. Pileus orange to greyish orange; lamellae remote (5-8); basidiospores 8-10 × 4-6 µm, $x_{mm} = 9 \times 4.9 \mu\text{m}$, $Q_m = 1.9$ **11. M. aff. crinis-equi**
14. Pileus 2-6 mm diam, reddish brown; stipe 4-10 mm long **12. M. subruforotula**
14. Pileus 2-28 mm diam, black, dark grey, greyish brown, brown or brownish orange; stipe 8-215 mm long **15**
15. Pileus black, dark grey or greyish brown; stipe 50-215 mm long **13A. M. nigrobrunneus f. nigrobrunneus**
15. Pileus brown to brownish orange; stipe 8-60 mm long ... **13B. M. nigrobrunneus "f. cinnamomeus"**
16. Pileus reddish brown; lamellae subdistant (11-13); stipe 4-10 mm long **12. M. subruforotula**
16. Pileus brown, brownish orange, brownish yellow, rusty brown, cream-brown, light yellow; lamellae distant (8-12); stipe 8-35(-60) mm long..... **17**
17. Pileus light yellow to yellowish white; rhizomorphs absent **14. M. straminiceps**
17. Pileus more deeply pigmented, brown, brownish orange, brownish yellow, rusty brown or cream-brown; rhizomorphs present or absent **18**
18. Stipe arising directly from rhizomorphs or from bamboo or other grass leaves **13B. M. nigrobrunneus "f. cinnamomeus"**
18. Stipe arising directly from dicot leaves..... **19**
19. Basidiospores narrow, 10-12 × 3-4 µm, $x_{mm} = 11.1 \times 3.5 \mu\text{m}$, $Q_{mm} = 3.2$ **15. M. guyanensis**
19. Basidiospores broader, 9-12 × 4-7 µm, $x_{mmr} = 10-10.2 \times 4.3-5.8$, $Q_{mmr} = 1.8-2.4$ **20**
20. Pileus disc brown with a cream-brown margin; basidiospores 9-11 × 4-5 µm, $x_{mm} = 10 \times 4.3 \mu\text{m}$, $Q_{mm} = 2$ **16. M. cafeyen**
20. Pileus disc brownish yellow or rusty brown with a greyish orange to light yellow margin; basidiospores 10-12 × 4.5-7 µm, $x_{mm} = 10.2 \times 5.8 \mu\text{m}$, $Q_{mm} = 1$ **17. M. ruforotula**

21. Pileipellis composed of a hymeniform layer of clavate to pyriform, non-setulose cells.....
.....(sect. *Globulares*)... **22**
21. Pileipellis composed of *Siccus*-type broom cells **29**
22. Pleurocystidia present, fusoid..... **18. M. calvus**
22. Pleurocystidia absent..... **23**
23. Basidiospores < 10 μm long..... **24**
23. Basidiospores > 18 μm long..... **25**
24. Cheilocystidia indistinct, basidiomorphous; pileus context thin but opaque, subhygrophanous; lamellae relatively broad (2-3 mm), strongly intervenose; pileus with brown to creamy brown disc and striae; basidiomes usually solitary.....
..... **19. M. albimyceliosus**
24. Cheilocystidia distinct, irregularly cylindrical to fusoid, ventricose or clavate; pileus context extremely thin, pellucid, hygrophanous; lamellae narrow (< 2 mm), often forked and intervenose; pileus with cream to orange white disc, pure white elsewhere; basidiomes usually in dense cespitose clusters **20. M. pellucidus**
25. Pileus with bluish grey, purple or violaceous pigments **26**
25. Pileus lacking bluish grey, purple or violaceous pigments **28**
26. Basidiomes robust, with pilei 30-90 mm diam, bluish grey to purplish grey overall when young becoming grayish brown with paler ridges in age; basidiospores 27-33 \times 5-6 μm ($x_{\text{mm}} = 30 \times 5.3 \mu\text{m}$) **21. M. mokfaensis**
26. Basidiomes smaller, with pilei 13-38 mm diam, striped, with dark violet to grayish violet disc and plicae and yellow to grayish yellow ridges; basidiospores 20-30 \times 4-7 μm ($x_{\text{mr}} = 21.3\text{-}28.2 \times 4.6\text{-}6.2 \mu\text{m}$)..... **27**
27. Pileus rather small, 13-20 mm diam, with dark violet to violet disc and plicae, and narrow pale grayish yellow to grayish white ridges; stipe up to 1.5 mm thick; basidiospores 21-30 \times 4-7 μm ($x_{\text{mm}} = 23.8 \times 5.3 \mu\text{m}$)..... **22. M. purpureostriatus**
27. Pileus larger, 14-38 mm diam, with violet to purple disc and narrow plicae, and broad yellow to cream ridges; stipe 1.5-3 mm thick; basidiospores 20-24.5 \times 5-6 μm ($x = 22.7 \times 5.6 \mu\text{m}$) **23. M. pseudopurpureostriatus**
28. Pileus 37-88 mm diam, yellowish green with darker olive green plicae; stipe 3-7 mm thick; cheilocystidia clavate to irregular, sometimes lobed, 5-12 μm diam; basidiospores 26-30 \times 4-5 μm ($x = 26.7 \times 4.4 \mu\text{m}$)..... **24. M. grandiviridis**
28. Pileus 15-19 (-33) mm diam, yellowish grey to greyish cream with a brown disc; stipe 1-2 mm thick; cheilocystidia broadly clavate, 11-16 μm diam; basidiospores 26-35 \times 5-7 μm ($x_{\text{mm}} = 30.4 \times 5.6 \mu\text{m}$)..... **25. M. laticlavatus**
29. Stipe none or rudimentary, lateral to strongly eccentric, less than 2 mm long
.....(sect. *Neosessiles*)... **26. M. tenuissimus**
29. Stipe central, well-developed **30**
30. Stipe insititious; lamellae free, well-separated from the stipe apex; coarse black rhizomorphs may be present..... (sect. *Leveilleani*)... **27. M. leveilleanus**
30. Stipe non-insititious; lamellae attached, typically adnexed to adnate; rhizomorphs absent
..... (sect. *Sicci*) **31**
31. Setae present on pileus, lamellae and/or stipe.....
..... (ser. *Spinulosi*) **32**
31. Setae absent..... **37**
32. Pleurocystidia and pleurosetae absent..... **33**
32. Pleurocystidia or pleurosetae present..... **35**
33. Basidiospores 6-7 \times 2.5-3.5 μm ; lamellae very crowded, > 22 with 4-5 series of lamellulae; pileus brown with a hint of olive **28. M. coarctatus**
33. Basidiospores 12-15 \times 3-5 μm ; lamellae close to subdistant, 12-22 with 2-3 series of lamellulae; pileus orange, brownish orange or reddish brown...
..... **34**
34. Pileus orange to brownish orange; lamellae close (16-22); pileosetae abundant, golden, up to 300 μm or more long; caulosetae simple, acicular
..... **29. M. trichotus**
34. Pileus reddish brown with brown margin; lamellae subdistant (12-18); pileosetae absent or rare, reddish brown, up to 115 μm long; caulosetae often with apical setulae **30. M. nummularius**
35. Basidiospores 10-13 \times 5.5-7 μm **31. M. coklatus**
35. Basidiospores 6-8 \times 2.5-4 μm **36**
36. Pileus smooth to striatulate, not venose-reticulate, brown with a hint of olive; lamellae very crowded (> 22) with 4-5 series of lamellulae; pileipellis formed from *Siccus*-type broom cells, simple pileosetae up to 60 μm long and transitional cells with 2-4 apical setulae up to 37 μm long
..... **28. M. coarctatus**
36. Pileus venose-reticulate, dark purplish brown; lamellae subdistant (10-12) with 3 series of lamellulae; pileipellis formed from *Siccus*-type broom plus arachnoid cells with 2-4 setulae 30-70 μm long **32. M. araneocephalus**
37. Stipe pruinose overall, pruinosity formed from irregularly cylindrical, obtuse to subacute, non-setulose cells, *Siccus* type cells typically absent on stipe surface (if present then they are in combination with non-setulose cells).....
..... (ser. *Atrorubentes*) **38**
37. Stipe glabrous or pruinose, if pruinose then pruinosity formed only from *Siccus*-type broom cells **47**

38. Cheilocystidia simple, cylindrical to clavate, *Siccus*-type broom cells absent from lamellar edge **39**
38. Cheilocystidia of *Siccus*-type broom cells **40**
39. Pileus disc golden yellow, margin orange to yellowish orange; stipe base dark reddish brown; basidiospore $x_{mm} = 12.2 \times 4.1 \mu\text{m}$, $Q_{mm} = 3.0$; basidiomes solitary on dicot leaves. **33. *M. auratus***
39. Pileus disc pale yellowish white, margin white, fading to white overall in age; stipe base pale orange to grayish orange; basidiospore $x_{mm} = 11.0 \times 4.1 \mu\text{m}$, $Q_{mm} = 2.7$; basidiomes cespitose on bamboo debris **34. *M. pseudopellucidus***
40. Pileus light yellow to cream overall; lamellae close to crowded (20-24) **35. *M. ochroleucus***
40. Pileus more deeply pigmented, olive brown, brown, reddish brown, brownish orange or yellowish brown; lamellae subdistant to close (12-20) **41**
41. Caulocystidia of two types: *Siccus*-type broom cells plus simple cylindrical cells **42**
41. Caulocystidia of one type: simple or lobed, cylindrical cells, *Siccus*-type broom cells absent from stipe surface **44**
42. Pleurocystidia present as scattered *Siccus*-type broom cells; pileus bright brownish orange to golden orange with paler creamy orange margin; lamellae distant (8-13), narrow (1-2 mm diam) **36. *M. luteolus***
42. Pleurocystidia absent; pileus dark brown to dark reddish brown with light brown to brownish orange margin; lamellae subdistant (12-20), broad (2-5 mm diam) **43**
43. Odor strongly of jasmine tea; lamellae pale yellowish white; pileus disc rugulose, dark reddish brown **37. *M. jasminodorus***
43. Odor absent; lamellae brownish orange to grayish brown or brown; pileus disc smooth, dark brown to brown or brownish orange **38B. *M. araucariae* var. *siccipes***
44. Caulocystidia apically lobed or forked; pileus with distinct yellow tones when young (disc yellowish brown, margin grayish yellow to yellowish orange) **39. *M. xestocephalus***
44. Caulocystidia all simple, cylindrical cells; pileus lacking yellow tones when young, with dark brown, reddish brown or olive tones **45**
45. Basidiospores $12-14 \times 3-4 \mu\text{m}$ with $x_{mm} = 12.8 \times 3.7 \mu\text{m}$, $Q_{mm} = 3.5$; pileus dark brown overall when young **40. *M. iras***
45. Basidiospores $8-12 \times 3-4 \mu\text{m}$ with $x_{mr} = 10.4-10.5 \times 3.9-4.0 \mu\text{m}$, $Q_{mr} = 2.6-2.7$; pileus olive or dark reddish brown overall when young **46**
46. Pileus disc smooth, dark olive to olive when young; stipe long, up to 100 mm long **41. *M. inthanonensis***
46. Pileus disc rugulose, dark reddish brown when young; stipe shorter, up to 45 mm long **38A. *M. araucariae* var. *araucariae***
47. Pleurocystidia absent (ser. *Leonini*) **48**
47. Pleurocystidia present (ser. *Haematocephali*) ... **54**
48. Pileus white to cream colored **42. *M. cremeus***
48. Pileus more deeply pigmented, olive, brown, reddish brown, brownish orange, greyish orange or orange **49**
49. Basidiospores $9-12 \times 5-6 \mu\text{m}$, $Q_m \leq 2.0$ **43. *M. hypochroides***
49. Basidiospores in the range $12-26 \times 3-5 \mu\text{m}$, $Q_m \geq 4.0$ **50**
50. Pileus conical, with a dark greyish brown disc and olive margin **44. *M. makok***
50. Pileus convex, brown, reddish brown, brownish orange, greyish orange or orange, lacking olive tones **51**
51. Stipe distinctly copper colored overall, 70-250 mm long **45. *M. cupreostipes***
51. Stipe base brown, dark brown or reddish brown (never copper colored), 13-90 mm long **52**
52. Pileus 10-43 mm diam; stipe 1-3 mm thick **46. *M. corneri***
52. Pileus 2-15 mm diam; stipe < 0.5 mm thick **53**
53. Pileus brown to reddish brown; lamellae distant (10-12); basidiospore $x_{mm} = 18.6 \times 4.4 \mu\text{m}$; basidiomes mostly on woody sticks **47. *M. imitarius***
53. Pileus brownish orange to greyish orange; lamellae subdistant (10-18); basidiospore $x_{mm} = 16.2 \times 3.7 \mu\text{m}$; basidiomes on dicot leaves **48. *M. bambusiniformis***
54. Basidiospores $8-12 \times 4-5(-6) \mu\text{m}$, $x_{mm} = 9.6 \times 4.8 \mu\text{m}$, $Q_{mm} = 2.1$ **49. *M. confertus***
54. Basidiospores $11-32 \times 3.5-5.5 \mu\text{m}$, $x_{mmr} = 12.6-28.2 \times 3.7-4.5 \mu\text{m}$, $Q_{mmr} = 3.0-6.6$ **55**
55. Basidiospores $25-32 \times 4-4.5 \mu\text{m}$, $x_{mm} = 28.2 \times 4.3 \mu\text{m}$, $Q_{mm} = 6.6$; stipe $100-195 \times 0.5 \text{ mm}$; lamellae distant (6-8); basidiomes on bamboo leaves **50. *M. ganyao***
55. Basidiospores $11-25 \times 3.5-5.5 \mu\text{m}$, $x_{mmr} = 12.6-22 \times 3.7-4.5 \mu\text{m}$, $Q_{mmr} = 3.0-5.9$; stipe < 100 mm long; lamellae distant to close (8-24); basidiomes typically on dicot leaves or wood, rarely on bamboo or other grass debris **56**

56. Lamellae close (20-24); stipe surface with caulocystidia formed from grass-like clusters of setulae 6-40 x 1-2 μm lacking a basal cell or arising from a rudimentary basal cell.... **51. *M. graminipes***
56. Lamellae distant to subdistant (8-18); stipe surface glabrous, lacking caulocystidia **57**
57. Basidiospores 11-15 x 3.5-5.5 μm , $x_{\text{mmr}} = 12.6-13.2 \times 4-4.5 \mu\text{m}$, $Q_{\text{mmr}} = 3.0-3.7$ **58**
57. Basidiospores 13-25 x 3.5-5 μm , $x_{\text{mmr}} = 16.1-22 \times 3.7-4.2 \mu\text{m}$, $Q_{\text{mmr}} = 4.2-5.9$ **59**
58. Pileus dark brown overall or with brown margin in age; lamellae olive brown to grayish olive or yellowish olive; *Siccus*-type broom cells often scattered on lamellar sides.....
..... **52. *M. brunneoolivascens***
58. Pileus disc bright brown, margin brownish orange to brownish yellow; lamellae yellowish white; *Siccus* type broom cells absent on lamellar sides....
..... **53. *M. suthepensis***
59. Pileus deep reddish brown, maroon, dark violet, purple, purplish brown or yellowish orange with white margin; basidiospores 19-25 x 3.5-5 μm , $x_{\text{mm}} = 20.7 \times 4.0 \text{ mm}$, $Q_{\text{mm}} = 5.2$ forms of
..... **54. *M. haematocephalus***
59. Pileus dark brown to brown, ferruginous, brownish orange, brownish yellow or grayish brown (lacking deep red, violet, purple or light yellow tones); basidiospores 13-19 x 3.5-5 μm , $x_{\text{mmr}} = 16.1-18.1 \times 4.0-4.2 \mu\text{m}$, $Q_{\text{mmr}} = 4.2-4.3$ **60**
60. Basidiomes on monocot leaves; pileus typically small, 1-5(-8) mm diam..... **61**
60. Basidiomes on dicot leaves and wood; pileus typically larger, 4-30(-48) mm diam..... **62**
61. Pileus dark brown overall; lamellae distant (8-11); stipe 5-15 mm long.....
..... **54B. *M. haematocephalus* "f. atrobrunneus"**
61. Pileus disc brown to ferruginous, margin ferruginous to grayish orange; lamellae subdistant (11-13); stipe 22-35 mm long.....
..... **55. *M. hypophaeus***
62. Pileus 4-15 mm diam, pallid, light brown to grayish brown with paler margin; cheilocystidia setulae 3-6 μm long..... **56. *M. aff. pallescens***
62. Pileus more robust, 8-30(-48) mm diam, more deeply pigmented, brown to brownish orange, yellowish brown with brownish cream margin; cheilocystidia setulae 3-15(-21) μm long
..... **57. *M. bondoi***

Enumeration of taxa

Section *Marasmius*, subsect. *Marasmius*

Type: *Marasmius rotula* (Scop.: Fr.) Fr.
= sect. *Pararotulae* Singer, Sydowia 18: 339.

1965. [Type: *Marasmius pararotula* Singer].
= subsect. *Pararotulae* (Singer) Singer, Fl. Neotrop. Monogr. 17: 92. 1976.

1. *Marasmius tantulus* Wannathes, Desjardin & Lumyong, **sp. nov.** (Fig. 2) MycoBank: MB512412.

Etymology: 'tantulus' = very small; referring to the very tiny basidiomes.

Pileus < 1.5 mm diametro, convexus, breviter umbilicatus, sine papilla, striatus, glaber, hebetatus, cinereo-creameus. *Contextus* creameus, tenuis. *Lamellae* adnatae usque collarium infirmus evolutum, remotae (3-4), angustae, creameae, haud marginatae, haud intervenosae. *Stipes* < 1 x < 0.3 mm, excentricus, sursum angustatus cum basi subbulbosa, subvelutinus, insititius, brunneus, sine rhizomorpha. *Odor* *saporque* non propria. *Basidiosporae* (17-)20-22 x 4 μm , fusoideae usque anguste clavatae, laeves, hyalinae, inamyloideae, tenuitunicatae. *Basidia* non observata. *Basidiolae* fusoideae usque clavatae. *Cheilocystidia* vulgaria, typi *Rotalis*; 18-23 x 10-18 μm , subglobosa usque late clavata, hyalina, inamyloidea, tenuitunicata; setulis divergentibus 1-2 x 1 μm , gongylodibus usque conicis, obtusis, confertis ad dimidium superiorem, hyalinis, tenui- usque crassetunicatis. *Pleurocystidia* nulla. *Pileipellis* hymeniformis, haud maculosus, typi *Rotalis*; 27-35 x 16-22 μm , late clavatus, subglobosus, pyriformis vel adumbratim inaequalis, hyalinus, inamyloideus, tenuitunicatus; setulis divergentibus 1-2 x 1 μm , gongylodibus usque conicis, obtusis, saepe confertis ad dimidium superiorem, flavis, crassetunicatis. *Trama pilei* intertexta, inamyloidea. *Trama lamellae* intertexta usque regularis, hyphis 3-6 μm diametro, cylindratis, laevibus, hyalinis, inamyloideis, tenuitunicatis, haud gelatinosis. *Stipitipellis* parallelus, hyphis 5-10 μm diametro, cylindratis cum eminentiis digitiformibus dispersis, laete flavis usque brunneo-flavis, laevibus, leniter dextrinoideis usque dextrinoideis, tenuitunicatis, haud gelatinosis. *Trama stipitis* subparallela, hyphis 4-6 μm diametro, cylindratis, hyalinis, laevibus, inamyloideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* nulla. *Fibulae* praesentes in omnibus texturis.

Typus: Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., dispersus usque gregarius in ligno, 28 July 2004, N. Wannathes 239 (CMU: **holotypus**).

Pileus < 1.5 mm diam., convex, shallowly umbilicate, without papilla, striate, glabrous, dull, greyish cream. *Context* cream, thin. *Lamellae* adnate to a poorly developed collarium, remote (3-4), narrow, cream, non-marginate, non-intervenose. *Stipe* < 1 x < 0.3 mm, eccentric, tapering upward with subbulbous at base, subvelutinus, insititious, brown; rhizomorphs absent. *Odor* and *taste* not distinctive.

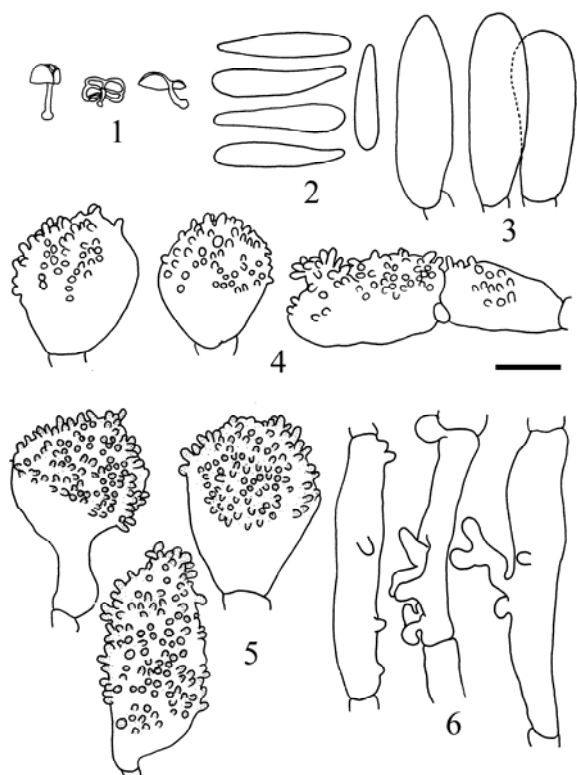


Fig. 2. *Marasmius tantulus* (N. Wannathes 239). 1. Basidiomes 2. Basidiospores 3. Basidioles 4. Cheilocystidia 5. Pileipellis 6. Stipitipellis, Scale bar 1 = 2 mm, 2-6 = 10 μ m

Basidiospores (17-)20-22 \times 4 μ m [$x_m = 20.1 \pm 1.3 \times 4.0 \pm 0 \mu$ m, $Q = 4.3-5.5$, $Q_m = 5.0$, $n = 9$ spores, $s = 1$ specimen], fusoid to narrowly clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* common, of *Rotalis*-type broom cells; main body 18-23 \times 10-18 μ m, subglobose to broadly clavate, hyaline, inamyloid, thin-walled; divergent setulae 1-2 \times 1 μ m, knob-like to conical, obtuse, dense over upper half of cell, hyaline, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, not mottled, composed of *Rotalis*-type broom cells; main body 27-35 \times 16-22 μ m, broadly clavate, subglobose, pyriform, or irregular in outline, hyaline, inamyloid, thin-walled; divergent setulae 1-2 \times 1 μ m, knob-like to conical, obtuse, often dense over upper half of cell, yellow, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 3-6 μ m diam., interwoven to regular, cylindrical, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 5-10 μ m diam., parallel, cylindrical with scattered finger-like projections, light yellow to

brownish yellow, smooth, weakly dextrinoid to dextrinoid, thin-walled, non-gelatinous. *Stipe trama* hyphae 4-6 μ m diam., subparallel, cylindrical, hyaline, smooth, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on wood, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., 28 July 2004, N. Wannathes 239 (CMU: **holotype**).

Discussion: *Marasmius tantulus* is characterized by very tiny basidiomes with greyish cream pilei less than 1.5 mm diam, collariate and remote lamellae (3-4), an eccentric stipe less than 1 mm long, and very long basidiospores with mean 20.1 \times 4.0 μ m. Few species of sect. *Marasmius* subsect. *Marasmius* have been described with basidiospores longer than 11 μ m, and none were previously known with basidiospores 20-22 μ m long. The most similar species are *M. arimanus* Dennis from Trinidad, and *M. rosulatus* Desjardin & R.H. Petersen from New Zealand. *Marasmius arimanus* differs in forming mummy brown pilei 2-3 mm diam. and basidiospores 11-14 \times 3.5-4 μ m (*vide* Singer, 1976). *Marasmius rosulatus* differs in forming pure white basidiomes with basidiospores 7.8-9.6 \times 4.0-4.8 μ m and grows on Cyperales leaves (Desjardin and Petersen, 1989).

2. *Marasmius delicatulus* Wannathes, Desjardin & Lumyong, **sp. nov.**

(Figs 3, 17-1)

Mycobank: MB512413

Etymology: 'delicatulus' = delicate; referring to the tiny, delicate basidiomes.

Pileus 1-3 mm diametro, convexus usque late convexus, subumbilicatus, sine papilla, striatus glaber, hebetatus, flavo-albus usque brunneo-creameus cum macula laete brunnea ad centrum. *Contextus* flavo-albus, tenuis. *Lamellae* adnatae usque collarium parvum, distantes (6-10), angustae, flavo-albae usque creameae, haud marginatae, haud intervenosae. *Stipes* 12 \times 0.1-0.2 mm, centralis, cylindratus, filo metallico similis, nodis dispersis, glaber, insititius, brunneus usque rubro-brunneus, plerumque rhizomorphis brunneis. *Odor saporque* non propria. *Basidiosporae* 8-10 \times 3.5-5 μ m, ellipsoideae, laeves, hyalinae, inamyloideae, tenuitunicatae. *Basidia* non observata. *Basidiolae*

fusoideae usque clavatae. *Cheilocystidia* vulgaria, typi *Rotalis*; 13-16 × 9-13 μm, clavata usque late clavata, subglobose, hyalina, inamyloidea, tenuitunicata; setulis divergentibus 1-2 × 1 μm, gongylobus usque conicis, obtusis, confertis ad dimidium superiorem, hyalinis usque pallide flavis, crassetunicatis. *Pleurocystidia* nulla. *Pileipellis* hymeniformis, haud maculosus, typi *Rotalis*; 18-23 × 14-18 μm, late clavatus usque subglobose, pyriformis, hyalinus, inamyloideus, tenuitunicatus; setulis divergentibus 1-2 × 1 μm, gongylobus usque conicis, obtusis, confertis ad dimidium superiorem, brunneo-flavis usque laete brunneis, crassetunicatis. *Trama pilei* intertexta, inamyloidea. *Trama lamellae* intertexta, hyphis 4-8 μm diametro, cylindratis usque inflatis, laevibus, hyalinis, inamyloideis, tenuitunicatis, haud gelatinosis. *Stipitipellis* parallelus, hyphis 3-5 μm diametro, cylindratis, brunneis, laevibus, leniter dextrinoideis usque inamyloideis, crassetunicatis (usque ad 1 μm), haud gelatinosis. *Trama stipitis* parallela, hyphis 2-4 μm diametro, cylindratis, hyalinis, laevibus, inamyloideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* nulla. *Fibulae* praesentes in omnibus texturis.

Typus: Phrae Province, Maung District, Pa Dang, Nong Kam Village, Nong Kam reservoir, dispersus usque gregarius in folis plantae dicotyledoneae, 18 August 2005, N. Wannathes 426 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 1-3 mm diam., convex to broadly convex, subumbilicate, without papilla, striate, glabrous, dull, yellowish white to brownish cream with a light brown central spot. *Context* yellowish white, thin. *Lamellae* adnate to a small collarium, distant (6-10), narrow, yellowish white to cream, non-marginate, non-intervenose. *Stipe* 5-12 × 0.1-0.2 mm, central,

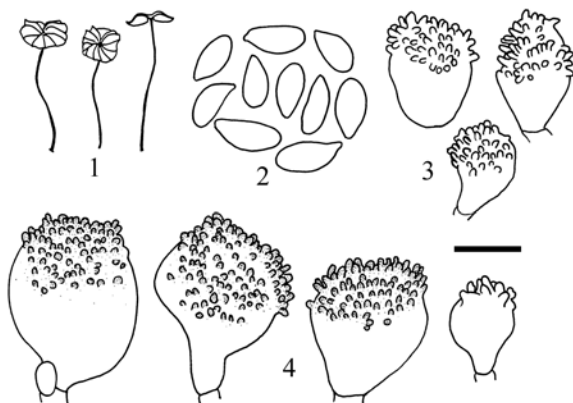


Fig. 3. *Marasmius delicatulus* (N. Wannathes 426). 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pileipellis Scale bar 1 = 4.5 mm, 2-4 = 10 μm

cylindrical, wiry, with scattered nodes, glabrous, insititious, brown to reddish brown; brown rhizomorphs usually present. *Odor* and *taste* not distinctive.

Basidiospores 8-10 × 3.5-5 μm [$x_{mr} = 8.6 \times 3.9-4.2 \mu m$, $x_{mm} = 8.6 \pm 0 \times 2.7 \pm 0.3 \mu m$, $Q_{mr} = 2.1-2.2$, $Q_{mm} = 2.2 \pm 0.1$, $n = 25$ spores, $s = 2$ specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* common, of *Rotalis*-type broom cells; main body 13-16 × 9-13 μm, clavate to broadly clavate, subglobose, hyaline, inamyloid, thin-walled; divergent setulae 1-2 × 1 μm, knob-like to conical, obtuse, dense over upper half of cell, hyaline to pale-yellow, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, not mottled, composed of *Rotalis*-type broom cells; main body 18-23 × 14-18 μm, broadly clavate to subglobose, pyriform, hyaline, inamyloid, thin-walled; divergent setulae 1-2 × 1 μm, knob-like to conical, obtuse, dense over upper half of cell, brownish yellow to light brown, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 4-8 μm diam., interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-5 μm diam., parallel, cylindrical, brown, smooth, weakly dextrinoid to inamyloid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 2-4 μm diam., parallel, cylindrical, hyaline, smooth, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Chiang Mai University, back area of Ang Kaew reservoir, 18 August 2004, N. Wannathes 255 (CMU, SFSU); Phrae Province, Maung District, Pa Dang, Nong Kam Village, Nong Kam reservoir, 18 August 2005, N. Wannathes 426 (CMU: **holotype**; SFSU: **isotype**).

Discussion: Distinctive features of *M. delicatulus* include tiny basidiomes with convex, yellowish white to brownish cream pilei 1-3 mm diam. that lack a papilla, collariate and distant lamellae (6-10), a small central, insititious stipe not arising from rhizomorphs, and moderately-sized basidiospores ($x_{mm} = 8.6 \times 4.1 \mu m$; $Q_{mm} = 2.2$). The new Thai species is morphologically similar to several other species. *Marasmius diminutivus* Y.S. Tan, Desjardin & Vikineswary, from Malaysia, differs in forming smaller (0.5-1 mm

diam.), conical pilei with a dark brown papilla, and slightly longer and narrower basidiospores with mean $Q = 2.4$ (Tan *et al.*, 2009). *Marasmius leucorotalis* Singer, as reported from Java by Desjardin *et al.* (2000), differs in forming larger, pure white pilei up to 7 mm diam. with a distinct black conical papilla, a larger stipe up to 32 mm long, and has slightly smaller basidiospores with mean $8.4 \times 3.7 \mu\text{m}$. *Marasmius arimanus* Dennis, from Trinidad, differs in forming mummy brown pilei and basidiospores $11-14 \times 3.5-4 \mu\text{m}$, while *Marasmius manuripiensis* Singer, from Bolivia, differs in forming white pilei 2-5 mm diam and a more robust stipe up to 0.5 mm thick (Singer, 1976).

3. *Marasmius somalomoensis* Antonín, Mycotaxon 88: 66. 2003. (Figs 4, 17-2)

Pileus 2-4 mm diam., convex, umbilicate, with a tiny papilla when young, papilla absent in age, sulcate, glabrous, dull, with a reddish brown spot in centre, surrounded by a pale zone, reddish brown with a hint of olive elsewhere. *Context* cream, thin. *Lamellae* adnate to a small collarium, subdistant (12-18), broad (0.5-1 mm), cream with brown edge, non-intervenose. *Stipe* $8-47 \times 0.3$ mm, central, cylindrical, wiry, with scattered nodes, glabrous, insititious, apex cream, base dark brown; rhizomorphs absent. *Odor* and *taste* not distinctive.

Basidiospores $8-10 \times 4-5 \mu\text{m}$ [$x_m = 8.8 \pm 0.6 \times 4.3 \pm 0.3 \mu\text{m}$, $Q = 1.8 - 2.2$, $Q_m = 2.1$, $n = 25$ spores, $s = 1$ specimen], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* common, of *Rotalis*-type broom cells; main body $11-19 \times 7-11 \mu\text{m}$, clavate to broadly clavate, hyaline, inamyloid, thin-walled; divergent setulae $2-3 \times 1 \mu\text{m}$, knob-like to conical, obtuse, dense over upper half of cell, brownish yellow to yellow, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, not mottled, composed of *Rotalis*-type broom cells; main body $18-23 \times 14-18 \mu\text{m}$, broadly clavate, subglobose, turbinate to pyriform, hyaline, inamyloid, thin-walled; divergent setulae $1-3 \times 1 \mu\text{m}$, knob-like to conical, obtuse, dense over upper half of cell, brown to light

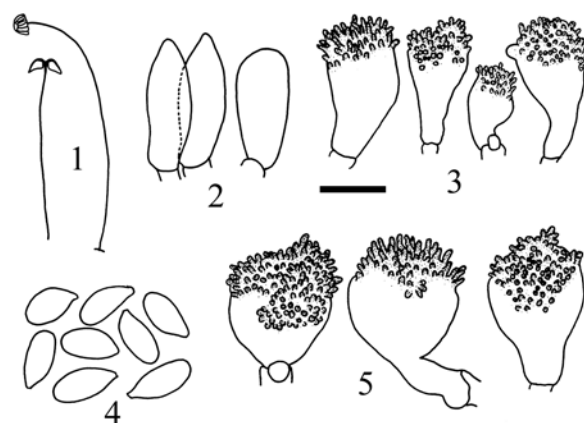


Fig. 4. *Marasmius somalomoensis* (N. Wannathes 232). 1. Basidiomes 2. Basidioles 3. Cheilocystidia 4. Basidiospores 5. Pileipellis, Scale bar 1 = 10 mm, 2-5 = 10 μm

brown, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 2-4(-8) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-5 μm diam., subparallel, cylindrical, dark brown, smooth, weakly dextrinoid to inamyloid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 3-6 μm diam., subparallel, cylindrical, hyaline, smooth, inamyloid, thin- to thick-walled (up to 1 μm), non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Sangasabhasri Land N $18^\circ 48.4'$ E $98^\circ 54.6'$ alt. 1,146 m., 27 July 2004, N. Wannathes 232 (CMU, SFSU).

Discussion: *Maramius somalomoensis*, originally described from material collected in Cameroon, is characterized by having a light brown to brownish orange pileus with darker papilla surrounded by a pale zone, moderately distant lamellae, basidiospores in the range $7-10 \times 3.7-5.5 \mu\text{m}$, and *Rotalis*-type pileipellis cells (Antonín, 2003). The Thai material differs from the protologue only in forming pilei with more reddish brown tones, more lamellae (12-18 vs 11-13) with brown edges, and slightly longer stipes (up to 47 mm vs 10-17 mm).

4. *Marasmius apatelius* Singer, Bull. Jard. Bot.Burx. 43: 332. 1964. (Figs 5, 17-3)

Pileus 2-10 mm diam., hemispherical to convex with or without a small papilla in umbilicus, striate, glabrous, dull, light brownish cream to yellowish brown with a brown central spot. *Context* yellowish white to greyish cream, thin. *Lamellae* adnate to a small collarium, subdistant (9-16), narrow, cream with or without brown edges, non-intervenose. *Stipe* 7-33 × 0.1-0.4 mm, central, cylindrical, wiry, glabrous, insititious, brown to reddish brown; rhizomorphs absent. *Odor* and *taste* not distinctive.

Basidiospores (6-)8-9(-10.5) × 3.5-4(5.5) μm [$x_{mr} = 7.2-8.9 \times 3.9-4.6 \mu\text{m}$, $x_{mm} = 8.0 \pm 0.6 \times 4.0 \pm 0.4 \mu\text{m}$, $Q_{mm} = 2.0 \pm 0.2$, $Q_{mr} = 1.7-2.3$, $n = 25$ spores, $s = 7$ specimens], ellipsoid, curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* 16-24 × 7-9 μm, clavate 4-spored. *Basidioles* clavate to fusoid. *Cheilocystidia* common, of *Rotalis*-type broom cells; main body (13)17-32(-34) × (7-)12-20 μm, clavate to broadly clavate, pyriform, hyaline, inamyloid, thin-walled; divergent setulae 0.5-4 × 0.8-1.5 μm, knob-like to conical, obtuse, pale-yellow to light brown, thick-walled. *Pleurocystidia* absent or of scattered *Rotalis*-type broom cells like the cheilocystidia. *Pileipellis* hymeniform, not mottled, composed of *Rotalis*-type broom cells; main body 16-35 × 10-20 μm, clavate to broadly clavate, pyriform or turbinate, hyaline, inamyloid, thin- to thick-walled; divergent setulae 1-3 × 0.5-1 μm, knob-like to conical, obtuse, dense over upper half of cell, yellow to light brown, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 3-6(-13) μm diam., interwoven to regular, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-6 μm diam., parallel to subparallel, cylindrical, light brown to brown, smooth, weakly dextrinoid to inamyloid, thin- to thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae (2-)3-7(-10) μm diam., parallel, cylindrical, hyaline, smooth, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous

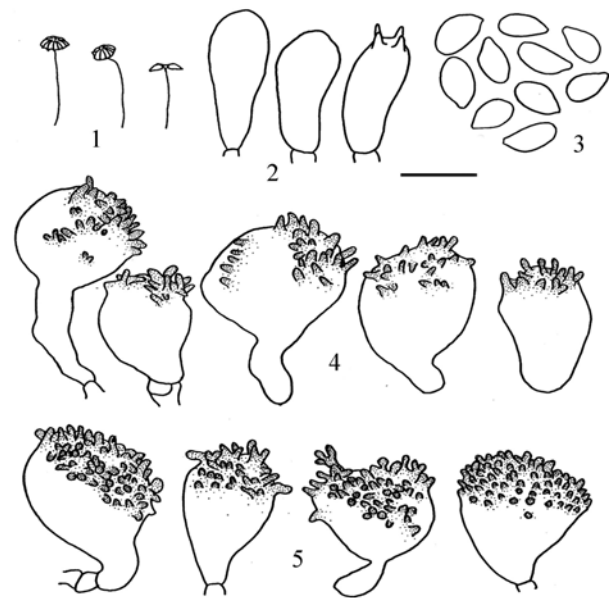


Fig. 5. *Marasmius apatelius* (N. Wannathes 251). 1. Basidiomes 2. Basidioles and basidia 3. Basidiospores 4. Cheilocystidia 5. Pileipellis, Scale bar 1 = 10 mm, 2-5 = 10 μm

leaves, bamboo debris or wood, Africa and northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m. 3 July 2003, N. Wannathes 017 (CMU, SFSU); same location, 21 August 2004, N. Wannathes 265 (CMU); Chiang Mai Province, Mushroom Research Centre, 27 km marker on Hwy 1095, 27 July 2003, N. Wannathes 035 (CMU); same location, 27 July 2003, N. Wannathes 043 (CMU); Chiang Mai province, Chiang Mai University, 11 August 2004, N. Wannathes 251 (CMU, SFSU); Phrae Province, Maung District, Pa Dang, Nong Kam Village, near Nong Kam reservoir, 18 August 2005, N. Wannathes 427 (CMU, SFSU); Chiang Mai Province, Chiang Mai University, close to Ang Kaew reservoir, 22 August 2005, N. Wannathes 437 (CMU, SFSU)

Discussion: The specimens from Thailand matched quite closely the descriptions of populations from Africa (Singer 1965; Pegler 1977), except for forming a few more lamellae per basidiome (13-14 vs 9-12). Distinctive features of this species include an entirely brown, umbilicate pileus lacking a dark central spot, collariate, subdistant lamellae with or without a pale brown edge, an absence of well-developed rhizomorphs, and small basidiospores with mean $7.2 \times 3.9 \mu\text{m}$. This is the first report of this species outside Africa. *Marasmius tubulatus* Petch, is similar, but

differs in forming darker brown pilei, fewer lamellae (10-13) that are also broader, and slightly longer basidiospores with mean $9.3 \times 4 \mu\text{m}$ (Tan et al., 2007).

A tetrapolar mating system was reported for Thai specimens of *M. apatelius* by Wannathes et al. (2007).

Section *Marasmius*, subsect. *Sicciformes*
Antonín, Acta Mus. Moraviae, Sci. Nat. 76: 145. 1991.

Type: *Marasmius curreyi* Berk. & Broome.

= subsect. *Penicillati* Singer sensu Singer, Fl. Neotrop. Monogr. 17: 121. 1976.

[Type: *Marasmius graminum* (Lib.) Berk. sensu Singer].

5. *Marasmius berambutanus* Desjardin, Retn. & E. Horak, Sydowia 52: 116. 2000. (Fig. 6)

Pileus 0.2-2 mm diam., hemispherical to convex, umbilicate, with or without a reddish brown to black papilla, striate, velutinous to hispidulous, dull, cream-brown. *Context* cream, thin. *Lamellae* adnate to a small collarium, distant (8), broad, cream, non-marginate, non-intervenose. *Stipe* 3-12 \times 0.1-0.2 mm, central, cylindrical, wiry, with scattered nodes, glabrous, insititious, apex white, base black, arising directly from black rhizomorphs. *Odor* and *taste* not distinctive.

Basidiospores 7-10 \times (3.5-)4-5.5 μm [$x_m = 8.4 \pm 0.6 \times 4.7 \pm 0.6 \mu\text{m}$, $Q = 1.4 - 2.3$, $Q_m = 2.1$, $n = 25$ spores, $s = 1$ specimen], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* cylindrical to clavate. *Cheilocystidia* abundant, of *Siccus*-type broom cells; main body 13-20 \times 7-11 μm , cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin-walled; apical setulae 3-19 \times 1.5-2.5 μm , cylindrical, often wavy and forked, obtuse to subacute, hyaline, thin-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled, composed of 3 types of cells: a) *Siccus*-type broom cells with main body 9-20 \times 8-12 μm , clavate to broadly clavate or pyriform, hyaline, inamyloid, thin-walled; apical setulae 3-15 \times 1-2.5 μm , conical to cylindrical, obtuse to subacute, yellow, thin-walled; b) transitional cells, similar to *Siccus*-type broom cells with main body 5-11 \times 6-9 μm , cylindrical to clavate, with 3-5 large apical setulae 9-28 \times 2-3

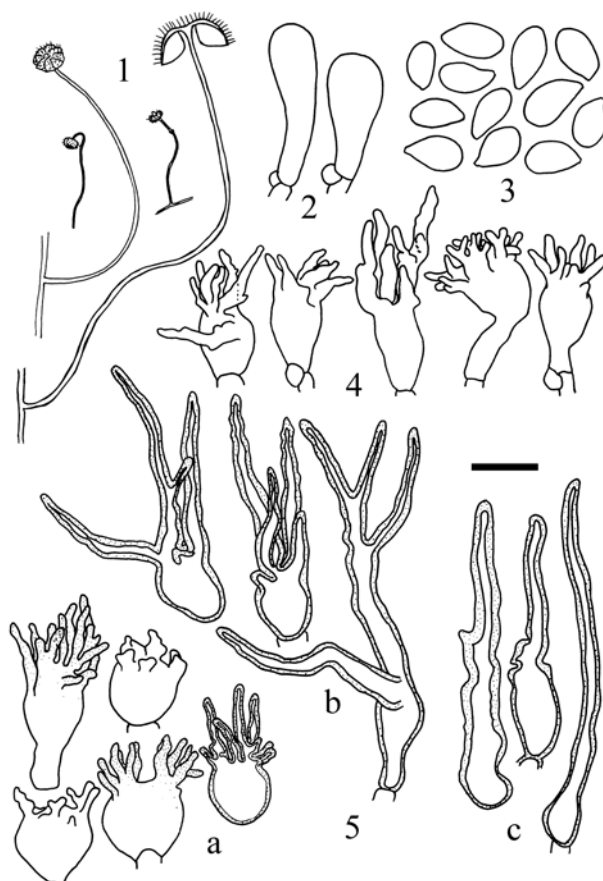


Fig. 6. *Marasmius berambutanus* (N. Wannathes 044). 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5a. *Siccus*-type pileipellis 5b. Cells transitional between broom cells and setae 5c. Pileosetae. Scale bar 1 = 2 mm, 2-5 = 10 μm

μm , cylindrical, conical to subacute, thick-walled; c) pileosetae 36-82 \times 6-8 μm , common, lanceolate to fusoid, hyaline to yellow, inamyloid, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 3-6 μm diam., interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae (2-)3-5 μm diam., subparallel, cylindrical, dark brown, smooth, dextrinoid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 2-4 μm diam., subparallel, cylindrical, hyaline, smooth, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on undetermined dicotyledonous leaves or on wood, Java, Malaysia and northern Thailand.

Material examined: Thailand. Chiang Mai Province, Mushroom Research Centre, 27 km marker on Hwy 1095, 27 June 2003, N. Wannathes 004 (CMU).

Discussion: *Marasmius berambutanus* is characterized by a very small, cream-brown

pileus with reddish brown to black papilla and a surface that is covered with small setae, collariate lamellae, and stipes that arise directly from rhizomorphs. The Thai material differs subtly from that described by Desjardin *et al.* (2000) from Indonesia in forming pilei with more brownish tones, and in forming basidiospores that are slightly shorter (mean $8.4 \times 4.7 \mu\text{m}$ vs $9.4 \times 4 \mu\text{m}$), and fits nicely into the range of variation reported by Tan *et al.* (2007) from populations in Malaysia.

A tetrapolar mating system was reported by Tan *et al.* (2007) based on Malaysian material.

6. *Marasmius purpureisetosus* Corner, Nova Hedwigia 111: 90. 1996. (Figs 7, 17-5)

Pileus 1-4 mm diam., hemispherical to convex, striate, hispid with brown to reddish brown setae, dull, margin orangish cream, disc brown and dark brown spot at centre. *Context* cream, thin. *Lamellae* adnate to a small collarium, subdistant (13-17), broad (0.5-1 mm), cream, non-marginate, non-intervenose. *Stipe* 15-55 \times 0.2-0.3 mm, central, cylindrical, wiry, with scattered nodes, glabrous, insititious, apex creamish brown, base light brown to brown; rhizomorphs present. *Odor* and *taste* not distinctive.

Basidiospores 8-10 \times 3-5 μm [$x_m = 8.6 \pm 0.6 \times 3.9 \pm 0.4 \mu\text{m}$, $Q = 1.6 - 2.9$, $Q_m = 2.3$, $n = 25$ spores, $s = 1$ specimen], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, composed of 2 types of cells: a) *Siccus*-type broom cells with main body 13-16 \times 7-10 μm , clavate to broadly clavate, hyaline to yellow, inamyloid, thick-walled; apical setulae 5-10 \times 2-3 μm , cylindrical to conical, obtuse, ranging from 2-4 per cell, yellow, thick-walled; b) non-setulose cells, 23-38 \times 6-8 μm , fusoid, hyaline, inamyloid, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, not mottled, composed of 3 types of cells: a) *Siccus*-type broom cells with main body 14-20 \times 8-15 μm , clavate to broadly clavate or pyriform, hyaline to pale yellow, inamyloid, thick-walled; apical setulae 4-15 \times 2-3 μm , conical to cylindrical, obtuse, brown to dark brown, thick-walled; b) transitional cells, similar to *Siccus*-type broom

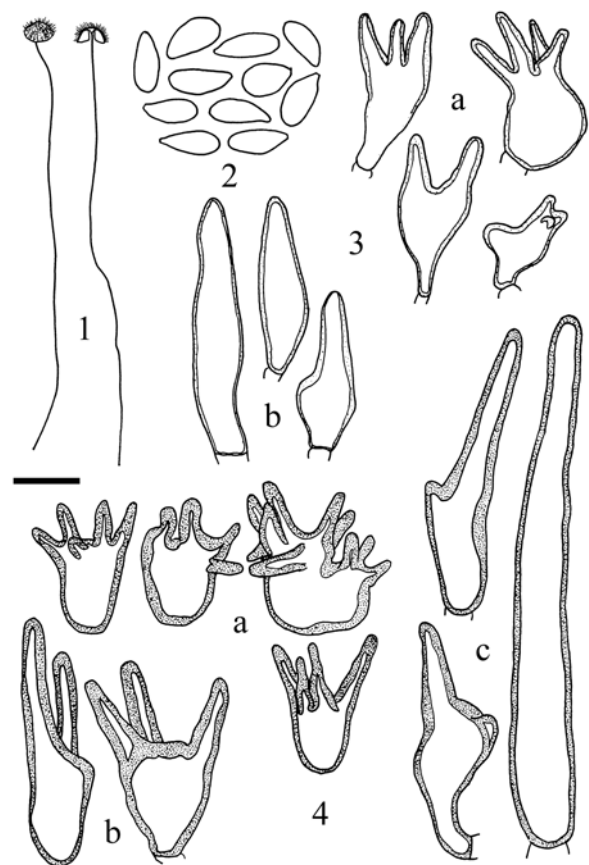


Fig. 7. *Marasmius purpureisetosus* (N. Wannathes 155). 1. Basidiomes 2. Basidiospores 3a. Cheilocystidia 3b. Cheiloseetae 4a. *Siccus*-type pileipellis 4b. Cells transitional between broom cells and setae 4c. Peleosetae, Scale bar 1 = 6.5 mm, 2-4 = 10 μm

cells with main body 17-36 \times 9-12 μm , clavate to broadly clavate, with only 2-3 large apical setulae 15-27 \times 3-5 μm , cylindrical, conical to subacute, thick-walled; c) pileosetae 80-350 \times 8-12 μm , common, lanceolate to fusoid, brown, inamyloid, thick-walled (up to 3 μm). *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 3-8(-10) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-5 μm diam., subparallel, cylindrical, dark brown, smooth, inamyloid to weakly dextrinoid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 3-6 μm diam., subparallel, cylindrical, hyaline, smooth, weakly dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution. Scattered to gregarious on undetermined dicotyledonous leaves, Java, Malaysia, northern Thailand and Singapore.

Material examined: Thailand. Chiang Mai Province, Doi Inthanon National Park, At 25 km marker on Highway 1,009, N 18° 32.5' E 98° 33.5' alt. 1,076 m., 10 June 2004, N. Wannathes 155 (CMU, SFSU).

Discussion: *Marasmius purpureisetosus* is characterized by a small pileus colored orangish cream with a brown disc and dark brown central spot, a hispid surface with brown to reddish brown pileosetae, subdistant and collariate lamellae, and a glabrous stipe with scattered nodes. *Marasmius purpureisetosus* and *M. berambutanus* are the only known members of section *Marasmius* with pileosetae. The two species differ by the features presented in the Key. The Thai specimens are nearly indistinguishable from those reported from Indonesia (Desjardin *et al.*, 2000) and Malaysia (Corner, 1996; Tan, 2008), although the pileosetae lacked purple tones.

7. *Marasmius brevicollis* Corner, Beih. Nova Hedwigia 111: 37. 1996. (Fig. 8)

Pileus 0.5-6 mm diam., hemispherical, umbilicate, striate to sulcate, with or without a papilla, glabrous to minutely velutinous, dull, brownish red to brownish purple. *Context* cream, thin. *Lamellae* adnate to a small collarium, distant to subdistant (6-9), broad, cream with brown edge, non-intervenose. *Stipe* 10-25 × 0.1-0.2 mm, central, cylindrical, wiry, with or without nodes, glabrous, insititious, brownish yellow, rhizomorph absent. *Odor* and *taste* not distinctive.

Basidiospores (16-)18-22(-23) × (3.5-)4-5.5 μm [$x_{mr} = 19.0-21.1 \times 4.0-5.1 \mu m$, $x_{mm} = 19.7 \pm 0.6 \times 4.6 \pm 0.5 \mu m$, $Q_{mr} = 3.8-4.9$, $Q_{mm} = 4.6 \pm 0.5$, $n = 25$ spores, $s = 5$ specimens], clavate to fusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 30-40 × 10-12 μm, cylindrical to clavate, 4-spored. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, of *Siccus*-type broom cells; main body 12-26 × 6-15(-19) μm, cylindrical to clavate, broadly clavate or pyriform, often branched, hyaline, inamyloid, thin-walled; apical setulae 1-6 × 1-1.5 μm, conical to cylindrical, obtuse to subacute, yellowish brown to dark brown, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 7-27(-30) × 9-15 μm, clavate to broadly clavate, pyriform or irregular in outline, usually branched, hyaline, inamyloid,

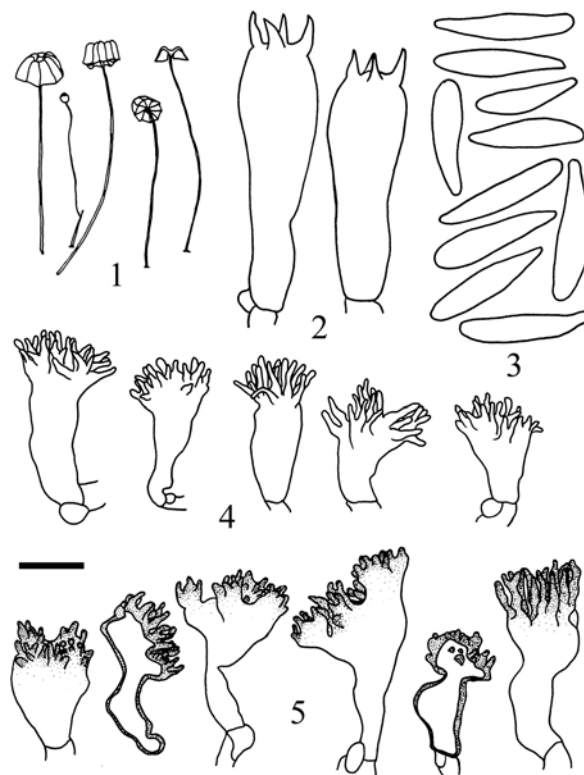


Fig. 8. *Marasmius brevicollis* (N. Wannathes 128). 1. Basidiomes 2. Basidia 3. Basidiospores 4. Cheilocystidia 5. Pileipellis, Scale bar 1 = 6.5 mm, 2-5 = 10 μm

thin- to thick-walled; apical setulae 1-3(-6) × 1-1.5 μm, conical to cylindrical, subacute to obtuse, yellowish brown to dark brown, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 3-5(-7) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 2-5 μm diam., subparallel, cylindrical, yellowish brown, smooth, dextrinoid, thin-walled, non-gelatinous. *Stipe trama* hyphae 2-5 μm diam., parallel, cylindrical, hyaline, smooth, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on undetermined monocotyledonous leaves and stems, Malaysia, northern Thailand and Singapore.

Material examined: Thailand. Chiang Mai Province, Mae Taeng District, Pa Deng Village, Pathammikaram temple on Hwy 1095, 7 August 2003, N. Wannathes 094(CMU) and 095 (CMU, SFSU); same location, 23 August 2003, N. Wannathes 123 and 126 (CMU); same location, 25 August 2003, N. Wannathes 128 (CMU, SFSU).

Discussion: Diagnostic features of *Marasmius brevicollis* include striate to

sulcate, brownish red to brownish purple pilei, distant and collariate lamellae with brown edges, a brownish yellow stipe, and clavate basidiospores with mean $19.7 \times 4.6 \mu\text{m}$. The Thai material matches quite closely the Malaysian material reported by Tan *et al.* (2007) except that the Thai populations form slightly larger basidiospores (with mean $19.7 \times 4.6 \mu\text{m}$ vs $18.8 \times 3.7 \mu\text{m}$) and fewer lamellae (6-9 vs 9-11). Both Thai and Malaysian specimens differ from the protologue based on Singaporean material (Corner, 1996) in forming a shorter stipe (10-25 mm vs 20-60 mm) and paler stipe color (brownish yellow vs dark brown). The Singaporean material has a broad range of the lamellae number (6-12) which encompasses the range of lamellae number for Thai and Malaysian populations. Corner (1996) suggested that *M. brevicollis* was allied with *M. nigrobrunneus* (Pat.) Sacc., but our molecular data (Fig. 1) indicate that *M. brevicollis* is allied with *M. purpureobrunneolus* and together they are placed in a clade distantly related to *M. nigrobrunneus*.

A tetrapolar mating system was reported for *M. brevicollis* by Tan *et al.* (2007) based on Malaysian material.

8. *Marasmius purpureobrunneolus* Henn., Monsunia 1: 151. 1900. (Fig. 9)

= *Marasmius acierufus* Corner, Beih. Nova Hedwigia 111: 25. 1996

Pileus 2-5 mm diam., hemispherical to truncately conical, umbilicate, with or without a papilla, striate, pruinose to pubescent, dull, dark reddish brown (9F8) to violet brown (11F4) with a reddish brown spot in centre. *Context* cream, thin. *Lamellae* adnate to a small collarium, subdistant (9-13), narrow, yellowish white with reddish brown edge, non-intervenose. *Stipe* 10-32 \times 0.1-0.2 mm, central, cylindrical, wiry, with or without nodes, glabrous, insititious, brown (6E5) to dark brown (7F7) overall; rhizomorphs absent. *Odor* and *taste* not distinctive.

Basidiospores (12-)13-16 \times 3-4 μm [$x_{\text{mr}} = 14.0-14.4 \times 3.2-3.3 \mu\text{m}$, $x_{\text{mm}} = 14.2 \pm 0.2 \times 3.2 \pm 0.1 \mu\text{m}$, $Q_{\text{mr}} = 4.4-4.5$, $Q_{\text{mm}} = 4.4 \pm 0.1$, $n = 25$ spores, $s = 2$ specimens], narrowly ellipsoid to fusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, of

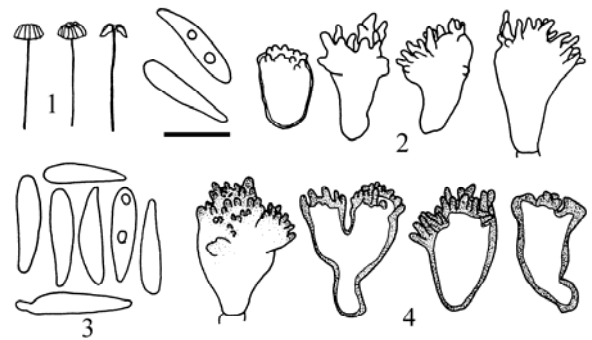


Fig. 9. *Marasmius purpureobrunneolus* (N. Wannathes 370). 1. Basidiomes 2. Cheilocystidia 3. Basidiospores 4. Pileipellis, Scale bar 1 = 13.5 mm, 2-4 = 10 μm

Siccus-type broom cells; main body 12-17 \times 8-13 μm , clavate to broadly clavate or irregular in outline, hyaline, inamyloid, thin- to thick-walled; apical setulae 1-3 \times 1 μm , cylindrical to conical, obtuse to subacute, pale yellow, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled, composed of *Siccus*-type broom cells; main body 15-25 \times 7-15 μm , clavate to broadly clavate, pyriform or irregular in outline, hyaline, inamyloid, thin- to thick-walled; apical setulae 1-3 \times 1 μm , conical to cylindrical, subacute to obtuse, yellowish brown, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 4-8(-13) μm diam., regular to interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-5 μm diam., subparallel, cylindrical, yellowish brown to brown, smooth, dextrinoid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae (2-)3-6 μm diam., subparallel, cylindrical, hyaline, smooth, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distributions. Scattered to gregarious on undetermined dicotyledonous leaves or on wood, Java, Malaysia and northern Thailand.

Material examined: Thailand. Chiang Mai Province, Mae Taeng District, "Water Conservation taste not distinctive. Area" Highway 1,095 at 22 km marker, N. 19° 7.5' E 98° 45.7' alt. 724 m. 5 July 2004, N. Wannathes 215 (CMU, SFSU); Chiang Mai Province, Doi Inthanon National Park, At 25 km marker on Highway 1,009, N 18° 32.5' E 98° 33.5' alt. 1,076 m., 27 June 2005, N. Wannathes 370 (CMU, SFSU).

Discussion: *Marasmius purpureobrunneolus* is characterized by striate, dark reddish brown to violet brown pilei, subdistant (9-13) lamellae with reddish brown edges, fusoid

basidiospores with mean $14.2 \times 3.2 \mu\text{m}$, and growth on dicotyledonous debris. We follow the species concept of *M. purpureobrunneolus* redefined by Desjardin *et al.* (2000) based on recently collected specimens from the type locality in the Bogor Botanical Garden, Java. The Thai specimens match nicely the data reported for material from Java (Desjardin *et al.*, 2000) and Malaysia (Tan, 2008). In the field *M. purpureobrunneolus* and *M. brevicolus* look very similar in size and color of the pilei. The two species differ in lamellae spacing (9-13 lamellae vs 6-9, respectively) and in basidiospore size ($x_{\text{mm}} = 14.2 \times 3.2 \mu\text{m}$ vs $19.7 \times 4.6 \mu\text{m}$, respectively).

9. *Marasmius pallenticeps* Singer, Fl. Neotrop. Monogr. 17: 127. 1976 (Fig. 10)

Pileus 0.5-1.5 mm diam., convex, subumbilicate with a papilla, striate, pruinose to glabrous, dull, cream to pale yellowish white (2A2) with a dark brown papilla. *Context* cream, thin. *Lamellae* adnate to a small collarium, distant (7-9), narrow, cream, non-marginate, non-intervenose. *Stipe* 3-6 \times 0.1 mm, central, cylindrical, wiry, glabrous, insititious, dark brown to black overall, arising directly from black rhizomorphs. *Odor* and *taste* not distinctive.

Basidiospores (7-)8-10(-11) \times 4.5-5.5 μm [$x_{\text{m}} = 9.0 \pm 0.8 \times 4.9 \pm 0.3 \mu\text{m}$, $Q = 1.4 - 2.2$, $Q_{\text{m}} = 1.7$, $n = 25$ spores, $s = 1$ specimen], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, of *Siccus*-type broom cells; main body 11-18 \times 5-10 μm , cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin-walled; apical setulae 2-4 \times 1(-1.5) μm , cylindrical to conical, obtuse to subacute, pale yellow to hyaline, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled, composed of *Siccus*-type broom cells; main body 9-13 \times 4-11 μm , cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin-walled; apical setulae 1-4 \times 1 μm , cylindrical to conical, subacute, pale yellow, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae

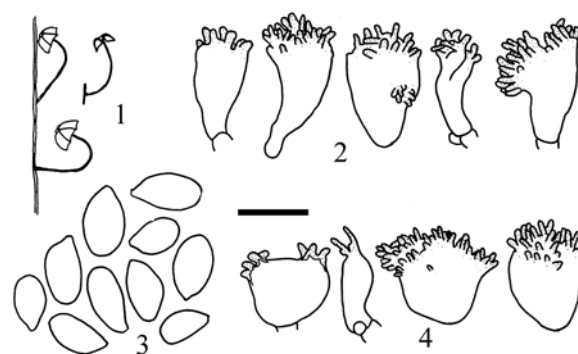


Fig. 10. *Marasmius pallenticeps* (N. Wannathes 346). 1. Basidiomes 2. Cheilocystidia 3. Basidiospores 4. Pileipellis, Scale bar 1 = 3.5 mm, 2-4 = 10 μm

3-5 μm diam., regular to interwoven, cylindrical, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-5 μm diam., subparallel, cylindrical, brown to dark brown, smooth, inamyloid to weakly dextrinoid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 1.5-3 μm diam., subparallel, cylindrical, hyaline, smooth, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on wood (dicotyledonous tree), Argentina, New Zealand, Indonesia and northern Thailand.

Material examined: Thailand. Chiang Mai Province, Mae Taeng District, Mae Sae Village, Pang Sa Ded Water Conservation Area, N 19° 14.6', E 98° 38.5' alt. 962 m., 26 June 2005, N. Wannathes 346 (CMU, SFSU).

Discussion: Distinctive features of *Marasmius pallenticeps* include a tiny pale cream-coloured pileus with dark brown papilla, distant (7-9), collariate lamellae, and a stipe arising directly from rhizomorphs. Our specimen is indistinguishable from the specimen reported from Java by Desjardin *et al.* (2000).

10. *Marasmius crinis-equi* F. Muell. ex Kalchbr., Grevillea 8: 153. 1880. (Fig. 11)

= *Marasmius equicrinis* F. Muell. ex Berk., J. Linn. Soc., Bot. 18: 383. 1881.

= *Androsaceus crinis-equi* (F. Muell. ex Kalchbr.) Overeem, Hoofd van Het Mus. Econ. Bot. Buitenzorg 1: 69. 1927.

= *Marasmius graminum* var. *equicrinis* (F. Muell. ex Berk.) Dennis, Trans. Brit. Mycol. Soc. 34: 416. 1951.

= *Marasmius repens* Henn., Engl. Bot. Jahrb. 23: 548. 1897.

= *Marasmius ramentaceus* (Pat.) Sacc. & Traverso, Syllog. Fung. 20:21. 1911.

= *Androsaceus ramentaceus* Pat., Ann. Jard. Bot. Buitenzorg 1: 107. 1897.

Pileus 0.5-4 mm diam., convex, umbilicate, papillate, striate, glabrous, dull, reddish brown to orange brown with dark brown papilla or spot in the center. *Context* cream, thin. *Lamellae* adnate to a small collarium, distant (8-10), narrow, cream to orangish yellow, non-marginate, non-intervenose. *Stipe* 4-6 × 0.1-0.2 mm, central, cylindrical, wiry, glabrous, insititious, dark brown to black overall, arising directly from copious, branched, black rhizomorphs. *Odor* and *taste* not distinctive.

Basidiospores (8-)10-12 × 4-4.5 μm [x_{mr} = 10.5-10.6 × 4.1-5.1 μm, x_{mm} = 10.6 ± 0.1 × 4.6 ± 0.7 μm, Q_{mr} = 2.1-2.6, Q_{mm} = 2.3 ± 0.4, n = 25 spores per 2 specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 22-23 × 6-7 μm, clavate, 4-spored. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, of *Siccus*-type broom cells; main body 11-22 × 7-12 μm, clavate to broadly clavate, subglobose or irregular in outline, hyaline, inamyloid, thin-walled; apical setulae 2-5 × 1-2 μm, conical to cylindrical, obtuse to subacute, pale yellow, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled, composed of *Siccus*-type broom cells; main body 9-22 × 8-21 μm, clavate to broadly clavate, pyriform, subglobose or irregular in outline, often branched, hyaline, inamyloid, thin-walled; apical setulae 1-5 × 1-1.5 μm, conical to cylindrical, subacute to obtuse, yellow to yellowish brown, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 3-8(-12) μm diam., regular to interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae (2-)3-6 μm diam., subparallel, cylindrical, brown to dark brown, smooth, dextrinoid, thick-walled (up to 3 μm), non-gelatinous. *Stipe trama* hyphae 2-5 μm diam., subparallel, cylindrical, hyaline, smooth, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on wood, cosmo-

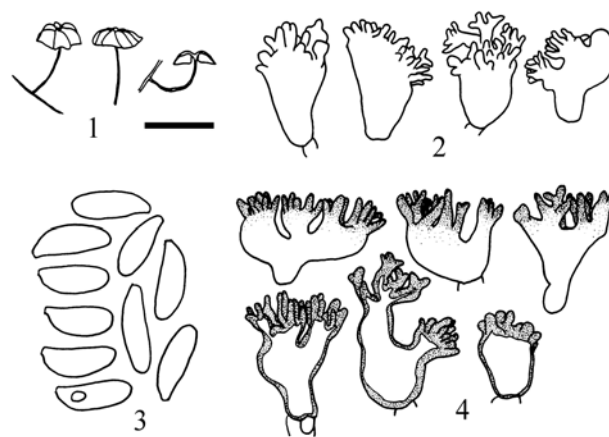


Fig. 11. *Marasmius crinis-equi* (N. Wannathes 182). 1. Basidiomes 2. Cheilocystidia 3. Basidiospores 4. Pileipellis, Scale bar 1 = 6.5 mm, 2-4 = 10 μm

politan in tropical habitats.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 25 July 2003, N. Wannathes 029 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Mae Sae Village, Pang Sa Ded Water Conservation Area, N 19° 14.6', E 98° 38.5' alt. 962 m., 26 June 2005, N. Wannathes 348 (CMU, SFSU).

Discussion: *Marasmius crinis-equi* is one of the more widely distributed species in the genus, reported throughout tropical areas of the world. It is the causal agent of 'Horse-hair Blight' that is known to be pathogenic on tea, rubber, cocoa and nutmeg crops (Pegler, 1983). This species grows on leaves and petioles of living or dead trees, and on monocotyledonous stems and clums (Singer, 1976) and its rhizomorphs are often found covering aerial branches of living trees. *Marasmius crinis-equi* is easy to recognize by a small, brown to brownish orange pileus with a dark brown central papilla, distant collariate lamellae, stipes that arise directly from black rhizomorphs, and *Siccus*-type pileipellis elements and cheilocystidia.

11. *Marasmius* aff. *crinis-equi* F. Muell. ex Kalchbr., Grevillea 8: 153. 1880 (Fig. 12)

Pileus 1-2 mm diam., hemispherical to convex, shallowly umbilicate, papillate, striate to sulcate, glabrous, dull, light orange (6A4) to greyish orange with a brown papilla. *Context* greyish cream, thin. *Lamellae* adnate to a small collarium, distant (5-8), broad, cream, non-marginate or with orangish cream edges, non-intervenose. *Stipe* 3-8 × 0.1-0.2 mm, central,

cylindrical, wiry, glabrous, insititious, black overall, arising directly from copious, branched, black rhizomorphs. *Odor* and *taste* not distinctive.

Basidiospores $8-10 \times 4-6 \mu\text{m}$ [$x_{\text{mr}} = 8.9-9.2 \times 4.6-5.1 \mu\text{m}$, $x_{\text{mm}} = 9.0 \pm 0.2 \times 4.9 \pm 0.4 \mu\text{m}$, $Q_{\text{mr}} = 1.8-2.0$, $Q_{\text{mm}} = 1.9 \pm 0.1$, $n = 25$ spores, $s = 2$ specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, of *Siccus*-type broom cells; main body $10-22 \times 8-13 \mu\text{m}$, clavate to broadly clavate or pyriform, hyaline, inamyloid, thin-walled; apical setulae $1-4 \times 1 \mu\text{m}$, conical to cylindrical, obtuse to subacute, yellow, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled, composed of *Siccus*-type broom cells; main body $11-19 \times 7-16 \mu\text{m}$, clavate to broadly clavate, pyriform or irregular in outline, hyaline, inamyloid, thin- to thick-walled; apical setulae $2-7 \times 1 \mu\text{m}$, cylindrical to conical, subacute to obtuse, yellowish brown to brown, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae $3-8 \mu\text{m}$ diam., interwoven, cylindrical, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae $4-8 \mu\text{m}$ diam., subparallel, cylindrical, black to dark brown, smooth, weakly dextrinoid to inamyloid, thick-walled (up to $1 \mu\text{m}$), non-gelatinous. *Stipe trama* hyphae $2-3(-5) \mu\text{m}$ diam., subparallel, cylindrical, hyaline, smooth, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on wood, northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Inthanon National Park, Junction of Highway 1,009 and road to Mae Chaem, N $18^\circ 31.6'$ E $98^\circ 29.6'$ alt. 1,703 m., 25 June 2004, N. Wannathes 182 (CMU, SFSU); same location, 3 July 2004, N. Wannathes 205 (CMU, SFSU).

Discussion: The two specimens reported here are morphologically similar to *Marasmius crinis-equi* in all taxonomically significant details except for having broader basidiospores with $Q_{\text{mm}} = 1.9$ (vs. 2.3) and paler pilei. The molecular data (Fig. 1), however, indicate that these specimens are not closely allied to *M. crinis-equi sensu stricto*. Until further material

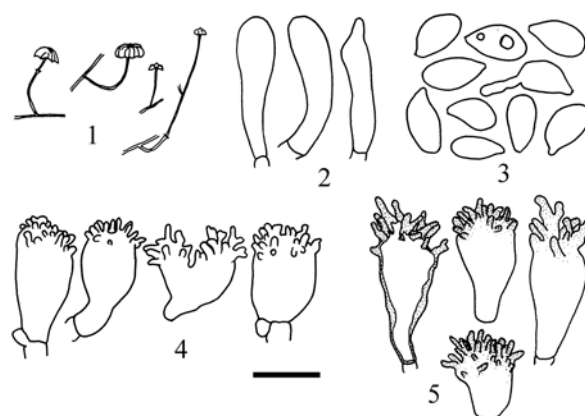


Fig. 12. *Marasmius* aff. *crinis-equi* (N. Wannathes 348). 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5. Pileipellis, Scale bar 1 = 4.5 mm, 2-5 = 10 μm

of this taxon is collected, we tentatively identify it as *M. aff. crinis-equi*.

12. *Marasmius subruforotula* Singer, Bull. Jard. Bot. Etat Brux. 34: 339. 1964 (Fig. 13)

Pileus 2-6 mm diam., hemispherical to convex, umbilicate, with or without a papilla, striate to sulcate, minutely velutinous, dull, reddish brown to brown with dark brown papilla or spot at the centre. *Context* cream, thin. *Lamellae* adnate to a small collarium, subdistant (11-13), narrow, cream-grey, non-marginate, non-intervenose. *Stipe* 4-10 \times 0.1-0.2 mm, central, cylindrical, wiry, glabrous, shiny, insititious, black overall, arising from leafy substrate or seldom directly from black rhizomorphs. *Odor* and *taste* not distinctive.

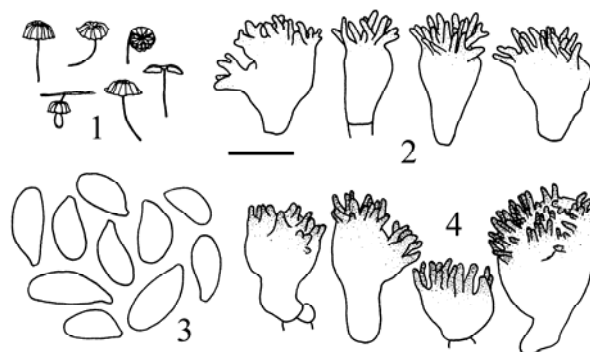


Fig. 13. *Marasmius subruforotula* (N. Wannathes 140). 1. Basidiomes 2. Cheilocystidia 3. Basidiospores 4. Pileipellis, Scale bar 1 = 10 mm, 2-4 = 10 μm

Basidiospores $8-10 \times 4-5 \mu\text{m}$ [$x_{\text{m}} = 9.5 \pm 1.0 \times 4.5 \pm 0.5 \mu\text{m}$, $Q = 1.8 - 2.5$, $Q_{\text{m}} = 2.1$, $n = 25$ spores, $s = 1$ specimen], ellipsoid, smooth,

hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, of *Siccus*-type broom cells; main body 14-16 × 6-12 μm, cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin-walled; apical setulae 2-5 × 1 μm, cylindrical, often forked, subacute, pale yellow, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled, composed of *Siccus*-type broom cells; main body 8-20 × 10-15 μm, clavate to broadly clavate or pyriform, hyaline, inamyloid, thin-walled; apical setulae 3-5 × 1 μm, cylindrical to conical, subacute, yellowish brown to brown, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 5-12(-18) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-6 μm diam., subparallel, cylindrical, dark brown to black, smooth, inamyloid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 3-6 μm diam., subparallel, cylindrical, hyaline to yellow, smooth, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on undetermined dicotyledonous leaves or on wood, Africa and Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Sangasabhasri Land on the way to Huai Kok Ma Village, N 18° 48.4' E 98° 54.6' alt. 1,146 m., 29 August 2003, N. Wannathes 140 (CMU, SFSU).

Discussion: *Marasmius subruforotula* is characterized by a small (2-6 mm), reddish brown pileus, subdistant (11-13) collariate lamellae, a short stipe 4-10 mm long, and ellipsoid basidiospores with mean 9.5 × 4.5 μm. The Thai specimens differ from *M. nigrobrunneus* "f. *cinnamomeus*" in forming reddish brown pilei and usually arising directly from leaves, although some basidiome arise from rhizomorphs. Our molecular data (Fig. 1) suggest that this species is distinct from *M. nigrobrunneus* and its forms, and is closer to *M. curreyi*. Until further material is available for comparison with the African, *M. subruforotula*, we are only tentatively accepting the Thai species as *M. subruforotula*.

13A. *Marasmius nigrobrunneus* (Pat.) Sacc. f. *nigrobrunneus* Syll. Fung. 11:37. 1895.

(Figs 14, 17-4)

Pileus 3-28 mm diam, hemispherical to convex when young, becoming plano-convex and shallowly umbilicate in age, with or without a small black papilla in the umbilicus, striate to plicate; surface dull, dry, glabrous to pruinose; disc dark grey to black, margin greyish brown (6F3) to brownish grey (9F2). *Context* thin, greyish white to cream. *Lamellae* adnate to a collarium, subdistant (9-17) with no lamellula, non-intervense, broad (2-4 mm), yellowish white when young, becoming pale-yellow in age, with brown to dark brown edges. *Stipe* 52-214 × 0.3-0.5 mm, central, cylindrical, wiry, shiny, solid, rarely with a few nodes, glabrous, insititious, apex olive brown grading to dark brown at the base when young, dark brown overall in age, arising directly from black rhizomorphs. *Odor* and *taste* not distinctive.

Basidiospores (6-)8-10(-13) × (3-)4-5(-7) μm [$x_{mr} = 7.4-10.6 \times 4.1-6.3 \mu\text{m}$, $x_{mm} = 9.0 \pm 0.9 \times 4.7 \pm 0.6 \mu\text{m}$, $Q = 1.4-2.9$, $Q_{mr} = 1.7-2.2$, $Q_{mm} = 1.9 \pm 0.1$, $n = 25$ spores, $s = 11$ specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 25-27 × 5.0-7.5 μm, clavate to cylindrical, 4-spored. *Basidioles* fusoid to cylindrical. *Cheilocystidia* common, of *Siccus*-type broom cells; main body (11-)14-20(-30) × (4-)7-14(-19) μm, cylindrical to clavate, pyriform or sometimes irregular in outline, hyaline, thin- to thick-walled; apical setulae (2-)3-9(-15) × 1-2(-2.5) μm, crowded, cylindrical or irregular in outline, obtuse to subacute, dark grey to black, inamyloid, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, mottled to weakly mottled, composed of 3 types of cells: a) *Siccus*-type broom cells with main body (11-)15-27 × (7-)10-15(-18) μm, clavate to broadly clavate, pyriform or sometimes irregular in outline, yellowish brown, inamyloid, thin- to thick-walled; apical setulae 2-9 × 1-2(-2.5) μm, cylindrical to conical or irregular in outline, obtuse to subacute, dark grey to black, inamyloid, thin- to thick-walled; b) *Globulares*-type cells, 14-28 × 11-12 μm, subglobose to clavate, sometimes irregular in

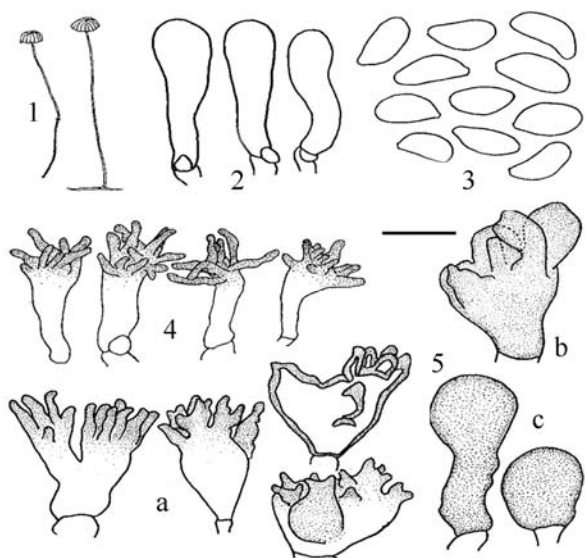


Fig. 14. *Marasmius nigrobrunneus* (N. Wannathes 294). 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5a. *Siccus*-type pileipellis 5b. Cells transitional between broom cells and non-setulose cells 5c. *Globulares*-type pileipellis, Scale bar 1 = 20 mm, 2-5 = 10 μ m

outline, dark grey to black, inamyloid, thin-walled; c) cells transitional between broom cells and non-setulose cells with main body 20-22 \times 15-17 μ m, broadly clavate to pyriform with a few knob-like apical setulae 6-13 \times 4-8 μ m, dark grey to black, thin- to thick-walled. *Pileus trama* interwoven; *lamellar trama* regular; hyphae 3-7 μ m diam, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 4-8 μ m diam, parallel, cylindrical, smooth, dark brown, dextrinoid, thick-walled (up to 2 μ m), non-gelatinous. *Stipe trama* hyphae 3-8 μ m diam, parallel, cylindrical, smooth, hyaline, inamyloid, thick-walled (up to 2 μ m). *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat, and known distribution: Scattered to gregarious on bamboo leaves and stems, or rarely on undetermined dicotyledonous leaves. Africa, Caribbean region, South America, India, Sri Lanka, Papua New Guinea, Vietnam, Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Sangra Sabhasri Land to Huai Kok Ma Village, N18°48.402', E98°54.617', 1146 meters, 30 Jun. 2003, N. Wannathes 010 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Mok Fa waterfall, N19°6.581', E98°46.353', 1014 meters, 13 Aug. 2003, N. Wannathes 101 (CMU, SFSU); same location, 29 Jun 2004, Y. S.

Tan 275 (CMU, SFSU); same location, 7 July 2004, N. Wannathes 223 (CMU, SFSU); same location, 25 Jun 2005, N. Wannathes 339 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Phadeng Village, Pathummikaram temple, N19°06' 28.8", E98°44' 47.3", 1050 meters, 25 Aug 2003, N. Wannathes 129 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Tung Joaw Village, N19°8.07', E98°38.90', 1423 meters, 20 Jun 2004, N. Wannathes 162 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Mae Sae Village, Pang Sa Ded Water Conservation Area, N19°14.60', E98°38. 46', 962 meters, 26 Jun 2005, N. Wannathes 347 (CMU, SFSU); Phrae Province, Maung District, Cherng Thong waterfall, 16 Aug 2005, N. Wannathes 416 (CMU, SFSU); same location, 19 Aug 2005, N. Wannathes 435 (CMU, SFSU); Chiang Rai Province, Maung District, Khun Con waterfall, N19°5' 38.6", E99°39' 7.4", 577 meters, 12 Jun 2005, N. Wannathes 302 and 311 (CMU, SFSU).

Discussion: The specimens of *Marasmius nigrobrunneus* from northern Thailand match quite closely those reported by Singer (1958, 1976) and Pegler (1983, 1986) from Sri Lanka, India, Sierra Leone, Trinidad, Bolivia and Argentina, including forming lamellae with greyish brown edges and stipes that often arise from black rhizomorphs. They differ only slightly from specimens reported from Vietnam (type; Patouillard, 1891) and Papua New Guinea (Desjardin and Horak, 1997) that lack a colored lamellar edge, and were not reported to arise from black rhizomorphs. The species is commonly found on bamboo debris and the combination of dark grey to greyish brown pileus, distant collariate lamellae with or without colored edge, long, black, wiry stipes often associated with rhizomorphs, and versiform pileipellis broom cells are distinctive features for the species. A recent type study was published by Yang (2000).

A tetrapolar mating system was reported by Wannathes *et al.* (2007) for *M. nigrobrunneus* based on specimens from northern Thailand.

13B. *Marasmius nigrobrunneus* "f. *cinnamomeus*" Wannathes, Desjardin & Lumyong nom. prov. (Fig. 15)

Etymology: '*cinnamomeus*' = cinnamon; referring to the color of the pileus.

Pileus 2-7(-15) mm diam., obtusely conical, umbilicate, with or without a papilla, striate to sulcate, glabrous to pruinous, dull, brown to orangish brown (6C5-C8) with a brown papilla or spot in the centre. **Context**

cream, thin. *Lamellae* adnate to a small collarium, distant to subdistant (8-11(-15)), broad, cream, non-marginate or with orange to brown edges, non-intervenose. *Stipe* 8-60 × 0.1-0.3 mm, central, cylindrical, wiry, glabrous, insititious, brown to dark brown overall, usually arising directly from rhizomorphs. *Odor* and *taste* not distinctive.

Basidiospores 8-11 × 4-5(-6) μm [$x_{mr} = 8.9-10.1 \times 4.3-5.4 \mu\text{m}$, $x_{mm} = 9.5 \pm 0.5 \times 4.7 \pm 0.4 \mu\text{m}$, $Q_{mr} = 1.9-2.1$, $Q_{mm} = 2.0 \pm 0.1$, $n = 25$ spores, $s = 7$ specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 31-37 × 6-10 μm, cylindrical to clavate, 4-spored. *Basidioles* cylindrical to clavate. *Cheilocystidia* abundant, of *Siccus*-type broom cells; main body 10-21(-32) × 6-12 μm, cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin-walled; apical setulae 2-4(-7) × 1-1.5 μm, cylindrical to conical, obtuse to subacute, pale yellow, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled, composed of 2 types of cells: a) *Siccus*-type broom cells with main body 8-18(-24) × 7-16 μm, clavate to broadly clavate, pyriform or irregular in outline, hyaline, inamyloid, thin- to thick-walled; apical setulae 2-6 × 1-1.5 μm, cylindrical to conical, subacute to obtuse, yellow to yellowish brown, thick-walled; b) non-setulose cells, scattered, 12-17 × 8-15 μm, clavate to broadly clavate, often branched, hyaline, inamyloid, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae

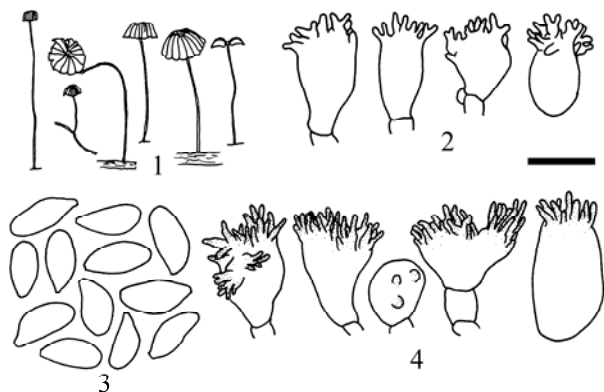


Fig. 15. *Marasmius nigrobrunneus* “f. *cinnamomeus*” (N. Wannathes 119). 1. Basidiomes 2. Cheilocystidia 3. Basidiospores 4. Pileipellis, Scale bar 1 = 20 mm, 2-4 = 10 μm

2-7(-12) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-4(-8) μm diam., subparallel, cylindrical, brown, smooth, dextrinoid, thin- to thick-walled, non-gelatinous. *Stipe trama* hyphae 3-6(-10) μm diam., parallel, cylindrical, hyaline, smooth, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on undetermined monocotyledonous leaves and stems, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Mae Taeng District, Pong Dued Hot Spring, on Hwy1095, 25 July 2003, N. Wannathes 025 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 25 July 2003, N. Wannathes 030 (CMU); same location, 29 June 2004, Y. S. Tan 281 (CMU, SFSU); same location, 25 June 2005, N. Wannathes 327 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Pa Deng Village, street to Pathammikaram temple on Hwy 1095, 22 August, 2003, N. Wannathes 119 and 120 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, New Waterfall, on 36 km. marker of Hwy1095, 20 August 2004, N. Wannathes 260 (CMU, SFSU).

Discussion: *Marasmius nigrobrunneus* “f. *cinnamomeus*” is distinct because of the following features: a brown to brownish orange (cinnamon) pileus 2-7(-15) mm diam., a stipe in the range 8-60 × 0.1-0.3 mm that arises directly from rhizomorphs or from the substrate, and is usually associated with non-bamboo grasses. *Marasmius nigrobrunneus* f. *nigrobrunneus* differs in forming basidiomes with a nearly black or dark greyish brown pileus, much larger stipe (52-214 × 0.5 mm,) and basidiomes that typically arise directly from a bamboo substrate (only occasionally arising from rhizomorphs). *Marasmius curreyi* Berk. & Broome described from Europe and North America, is another grass-loving species but it differs in forming pilei with more orange tones, and lacks of rhizomorphs.

A molecular dataset composed only of ITS sequences of *M. nigrobrunneus* with *M. curreyi* as outgroup, indicates that f. *nigrobrunneus* forms a clade distinct from “f. *cinnamomeus*”, providing support for recognition of the latter as a distinct form (Fig. 16)

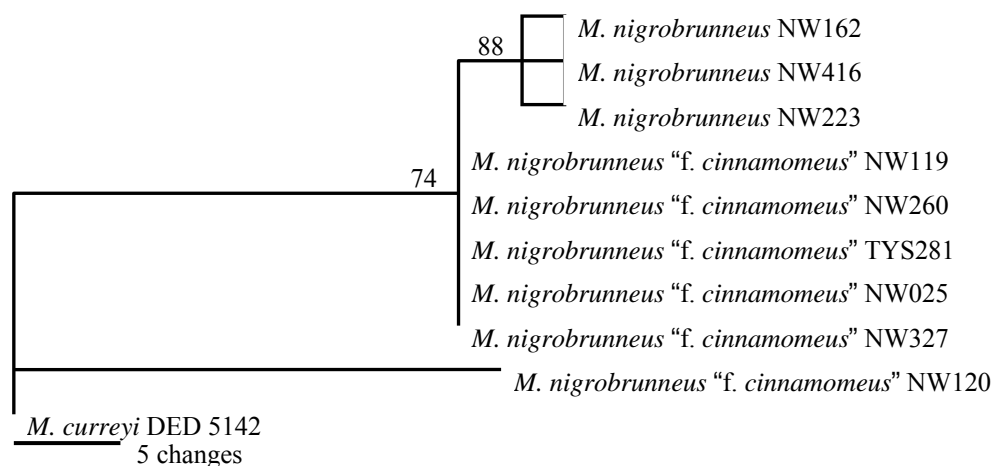


Fig. 16. Branch and bound tree of the *Marasmius nigrobrunneus* species complex. Numbers above branches represent support from 2000 bootstrap replicates

14. *Marasmius straminiceps* Wannathes, Desjardin, & Lumyong, Mycol. Res. 111: 991. 2007. (Fig. 18)

Pileus 2-4 mm diam, hemispherical to convex, subumbilicate to depressed, with or without a papilla, striate, dull, dry, glabrous, light yellow (4A4) to yellowish white (3A2) with a reddish brown central spot. *Context* thin, yellowish white (3A2). *Lamellae* adnate to a collarium, distant (9-10) with no lamellula, non-intervenose, narrow, cream, non-marginate. *Stipe* 11-35 × 0.1-0.3 mm, central, cylindrical, tough, terete, glabrous, insititious, yellowish white at apex, brown to dark brown at base; rhizomorphs absent. *Odor* and *taste* not distinctive.

Basidiospores (7-)8-10(-12) × 4-5(-6.5) μm [$x_{mr} = 8.4-9.4 \times 4.4-5.1$ μm, $x_{mm} = 8.9 \pm 0.7 \times 4.8 \pm 0.5$ μm, $Q = 1.4-2.2$, $Q_{mr} = 1.8-1.9$, $Q_{mm} = 1.8 \pm 0.1$, $n = 25$ spores, $s = 2$ specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 25-30 × 6-8 μm, clavate, 4-spored. *Basidioles* clavate to fusoid. *Cheilocystidia* common, of *Siccus* type broom cells; main body (7-)10-18 × (4-)7-12 μm, clavate to broadly clavate, pyriform, cylindrical or irregular in outline, rarely lobed, hyaline, thin-walled; apical setulae (2-)4-6(-7) × 0.8-1.5 μm, cylindrical to conical or irregular in outline, obtuse to subacute, hyaline to pale-yellow, inamyloid, thin- to thick walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, not mottled, composed of *Siccus*-type broom cells; main body 11-20 × 6-10 μm, cylindrical to clavate,

broadly clavate or sometimes irregular in outline, rarely lobed, hyaline, thick-walled apically, thin-walled elsewhere; apical setulae (1-)3-6(-7) × 1-2 μm, cylindrical to conical, usually wavy in outline, obtuse to subacute, pale yellow, inamyloid, thin- to thick-walled. *Pileus trama* and *lamellar trama* interwoven; hyphae (2-)3-6 μm diam, cylindrical, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-7 μm diam, parallel, cylindrical, smooth, brown, weakly dextrinoid to dextrinoid, thin-walled, non-gelatinous; *Stipe trama* hyphae (2-)4-8 μm diam, parallel, cylindrical, smooth, hyaline, weakly dextrinoid to dextrinoid, thin- to thick-walled (up to 1 μm). *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat, and known distribution. Scattered to gregarious on undetermined dicotyledonous leaves or wood. Northern Thailand.

Material examined. Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mok Fa waterfall on Hwy 1095, N19° 6.581', E98° 46.353', 1014 meters, 13 Aug. 2003, N. Wannathes106 (CMU, SFSU); Chiang Mai Province, Doi Inthanon National Park, junction of Hwy1009 and road to Mae Chem, N18° 31.58', E98° 29.64', 1703 meters, 28 Jul. 2004, N. Wannathes 244 (CMU: **holotype**; SFSU: **isotype**); Chiang Mai Province, Mae Taeng District, New Waterfall, on 36 km. marker of Hwy1095, N. Wannathes 256 (CMU, SFSU).

Discussion: Distinctive features of this new species include the following: a pale yellow (stramineus), umbilicate pileus with a reddish brown spot; collariate, distant

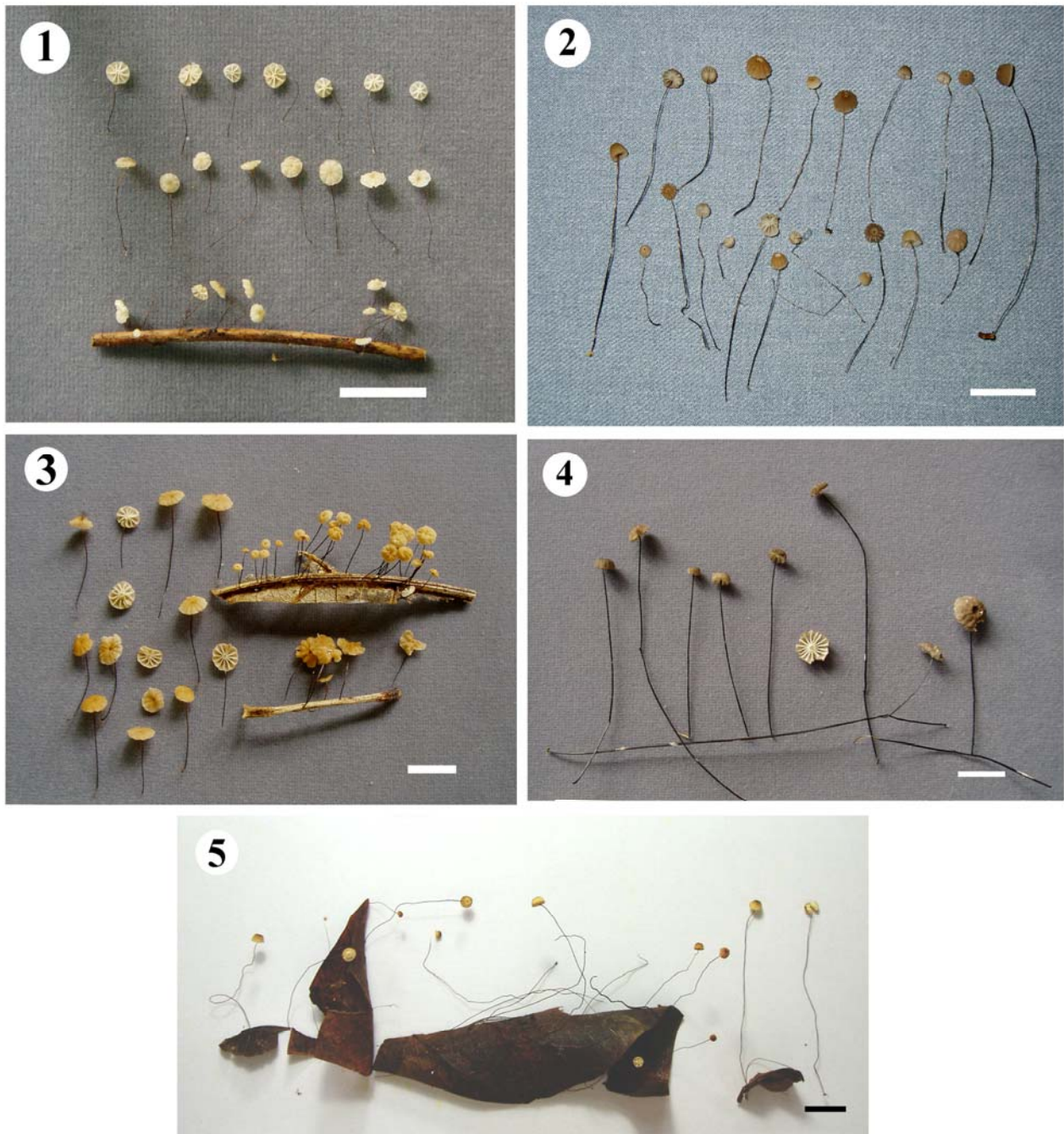


Fig. 17. Basidiomata of *Marasmius* section *Marasmius*. 1. *M. delicatulus* (N. Wannathes 426) 2. *M. somalomoensis* (N. Wannathes 232) 3. *M. apatelius* (N. Wannathes 427) 4. *M. nigrobrunneus* (N. Wannathes 435) 5. *M. purpureisetosus* (N. Wannathes 155), Scale bars = 20 mm

(9-10), non-marginate lamellae; a lack of obvious rhizomorphs; basidiospores with mean of $8.9 \times 4.8 \mu\text{m}$ and $Q_{\text{mm}} = 1.8$; *Siccus*-type broom cells on pileipellis and lamellar edges; and growth on dicotyledonous leaves. These features indicate placement in sect. *Marasmius* subsect. *Sicciformis*. *Marasmius stramineiceps* is phenetically similar to *M. conicopapillatus* Henn., but the latter species differs in forming a white to cream-buff pileus with a distinctive, rather large conical papilla, forms black

rhizomorphs, has thick-walled cheilocystidia, and narrower basidiospores with mean $10.3 \times 4.3 \mu\text{m}$ and $Q_{\text{mm}} = 2.4$ (Desjardin *et al.* 2000). The new species is macromorphologically similar to *M. platyspermus* Singer, a species described from Argentina, but the latter forms *Rotalis*-type broom cells and belongs in subsect. *Marasmius* (Singer 1976).

A tetrapolar mating system was reported for *M. stramineiceps* by Wannathes *et al.* (2007).

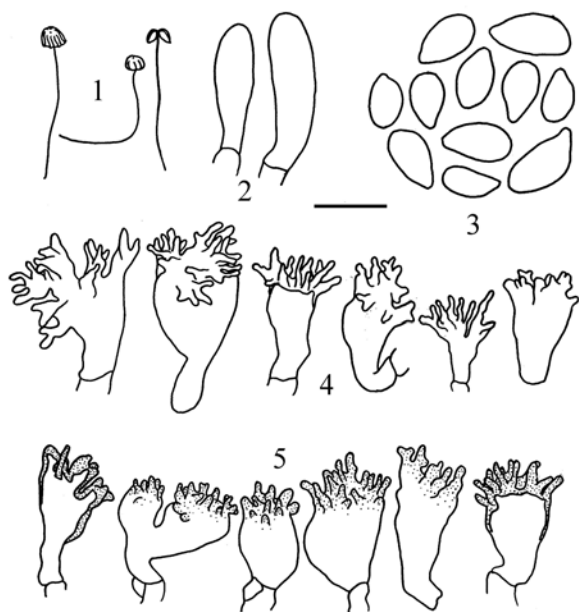


Fig. 18. *Marasmius stramineiceps* (N. Wannathes 244). 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5. Pileipellis, Scale bar 1 = 10 mm, 2-5 = 10 μ m

15. *Marasmius guyanensis* Mont., Ann. Sci. Nat., Bot., sér. 4, 1:114. 1854. (Fig. 19)

Pileus 0.5-4 mm diam, hemispherical to convex, umbilicate, with or without small dark reddish brown papilla in umbilicus, striate, dull, dry, glabrous; disc brown (7E6-7), margin brownish yellow to orange (6B7-8). *Context* thin, yellowish orange (4A6). *Lamellae* adnate to a collarium, distant (6-11) with no lamellula, non-intervenose, narrow, yellowish orange (4A6), non-marginate. *Stipe* 15-26 \times 0.2-0.3 mm, central to eccentric, cylindrical, terete, tough, glabrous, insititious, dark reddish brown overall; rhizomorphs usually present. *Odor* and *taste* not distinctive.

Basidiospores 10-12 (-15) \times 3-4(-5) μ m [$x_{mm} = 11.6 \pm 0.7 \times 3.8 \pm 0.3 \mu$ m, $x_{mr} = 11.0-12.4 \times 3.4-4.2 \mu$ m, $Q_{mm} = 3.1 \pm 0.1$, $Q_{mr} = 3.0-3.3$, $n = 25$ spores, $s = 5$ specimens], ellipsoid, *siccus*-type broom cells; main body 10-21 \times 6-11(-20) μ m, cylindrical to pyriform, turbinate, subglobose or sometimes irregular in outline, rarely lobed, hyaline, inamyloid, thin-walled; apical setulae 1-5 \times 1 μ m, cylindrical to conical or irregular in outline, obtuse to subacute, brownish yellow, inamyloid, thin- to thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 3-7(-9) μ m diam, interwoven, cylindrical, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipiti-*

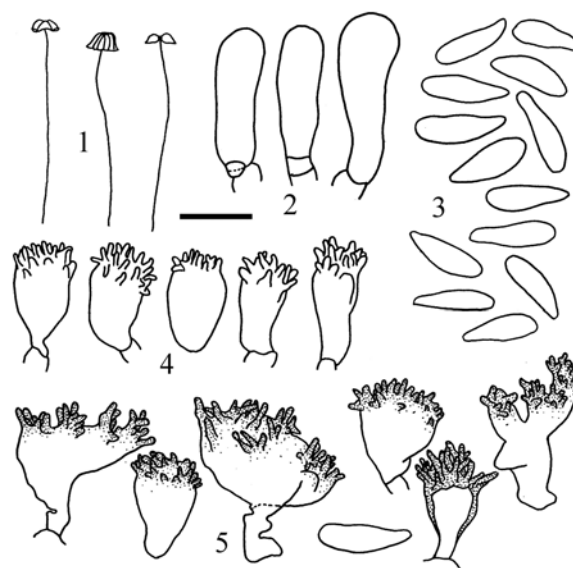


Fig. 19. *Marasmius guyanensis* (N. Wannathes 254). 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5. Pileipellis, Scale bar 1 = 5 mm, 2-5 = 10 μ m

pellis hyphae 3-6 μ m diam, parallel, cylindrical, smooth, light brown to brown, inamyloid, thick-walled (up to 2 μ m), non-gelatinous. *Stip trama* hyphae 2-5 μ m diam, parallel, cylindrical, smooth, hyaline to pale-yellow, weakly dextrinoid to inamyloid, thin-walled. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat, and known distribution: Scattered to gregarious on undetermined dicotyledonous leaves. Caribbean region, Indonesia, South America, Singapore, Thailand.

Material examined: Thailand. Chiang Mai Province, Mae Taeng District, "Water Conservation Area" Highway 1,095 at 22 km marker, N. 19° 7.5' E 98° 45.7' alt. 724 m., 2 July 2003, N. Wannathes 015 (CMU, SFSU); same location, 5 July 2004, Y. S. Tan 314 (CMU, SFSU); Chiang Mai Province, Mushroom Research Centre, 27 km marker on Hwy 1095, 28 July 2003, N. Wannathes 046 (CMU); Chiang Mai Province, Chiang Mai University, 11 Aug. 2004, N. Wannathes 254 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Doi Huai Kom Bang in Papae Village, 23 August 2004, N. Wannathes 280 (CMU, SFSU).

Discussion: The material from Thailand differs slightly from that described by Desjardin *et al.* (2000) from Indonesia in forming pilei with more brown tones and less orange tones, and in forming basidiospores that are slightly shorter (mean of 11.1 \times 3.5 μ m vs. 12.1 \times 3.6 μ m). In other details, the two populations are similar.

A tetrapolar mating system was reported for *M. guyanensis* by Wannathes *et al.* (2007) based on Thai specimens.

16. *Marasmius cafeyen* Wannathes, Desjardin & Lumyong, **sp. nov.** (Fig. 20)
MycoBank: MB512414

Etymology: ‘cafeyen’ (Thai) = coffee with milk; referring to the color of the pileus.

Pileus 2-8 mm diametro, hemisphaericus usque convexus, umbilicatus, cum vel sine papilla atrobrunnea, striatus usque sulcatus, minute velutinus, hebetatus, margine creameo-brunneo usque creameo-flavo, disco brunneo cum papilla vel macula atrobrunnea ad centrum. *Contextus* creameus, tenuis. *Lamellae* adnatae usque collarium parvum, distantes (8-12), latae, flavo-albae, haud marginatae, haud intervenosae. *Stipes* 6-31 × < 0.2 mm, centralis, cylindratus, filo metallico similis, glaber, insititius, apice flavo-albo, basi atrobrunnea interdum cum rhizomorphis. *Odor saporque* non propria. *Basidiosporae* 9-11 × 4-5 μm, ellipsoidae, laeves, hyalinae, inamyloidae, tenuitunicatae. *Basidia* non observata. *Basidiolae* fusioideae usque clavatae. *Cheilocystidia* abundantia, typi *Sicci*; 9-17 × 8-13 μm, clavata usque late clavata vel pyriformia, hyalina, inamyloidea, tenuitunicata; setulis apicalibus 2-6 × 1 μm, cylindratis usque conicis, saepe furcatis, obtusis usque subacutis, pallide flavis, crassetunicatis. *Pleurocystidia* nulla. *Pileipellis* hymeniformis, leniter maculosus, typi *Sicci*; 12-18(-25) × 7-14 μm, clavatus usque late clavatus, pyriformis vel adumbratim inaequabilis, raro ramosus, hyalinus usque pallide flavus, inamyloideus, tenui- usque crassetunicatus; setulis apicalibus 2-3 × 1 μm, conicis usque cylindratis, subacutis usque obtusis, flavo-brunneis usque brunneis, crassetunicatis. *Trama pilei* intertexta, inamyloidea. *Trama lamellae* regularis usque intertexta, hyphis 4-7(-10) μm diametro, cylindratis usque inflatis, laevibus, hyalinis, inamyloideis, tenuitunicatis, haud gelatinosis. *Stipitipellis* subparallelus, hyphis 3-5 μm diametro, cylindratis, brunneis usque atrobrunneis, laevibus, dextrinoideis, crassetunicatis (usque ad 1 μm), haud gelatinosis. *Trama stipitis* subparallela, hyphis 2-5 μm diametro, cylindratis, hyalinis, laevibus, inamyloideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* nulla. *Fibulae* praesentes in omnibus texturis.

Typus: Chiang Mai Province, Mae Taeng District, Pathummikaram temple in Pa Deng Village, dispersus usque gregarius in folis plantae dicotyledoneae, 25 August 2003, N. Wannathes 130 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 2-8 mm diam., hemispherical to convex, umbilicate, with or without dark brown papilla, striate to sulcate, minutely velutinous, dull, margin creamish brown to creamish yellow, disc brown with a dark brown papilla or spot at the centre. *Context* cream, thin. *Lamellae* adnate to a small collarium, distant (8-12), broad, yellowish white, non-marginate,

non-intervenose. *Stipe* 6-31 × < 0.2 mm, central, cylindrical, wiry, glabrous, insititious, apex yellowish white, base dark brown; rhizomorphs sometimes present. *Odor* and *taste* not distinctive.

Basidiospores 9-11 × 4-5 μm [$x_{mr} = 9.4-10 \times 4.2-4.4 \mu m$, $x_{mm} = 9.8 \pm 0.3 \times 4.3 \pm 0.1 \mu m$, $Q_{mr} = 2.2-2.4$, $Q_{mm} = 2.3 \pm 0.1$, $n = 25$ spores, $s = 3$ specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidiolae* fusoid to clavate.



Fig. 20. *Marasmius cafeyen* (N. Wannathes 130). 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pileipellis, Scale bar 1 = 13 mm, 2-4 = 10 μm

Cheilocystidia abundant, of *Siccus*-type broom cells; main body 9-17 × 8-13 μm, clavate to broadly clavate or pyriform, hyaline, inamyloid, thin-walled; apical setulae 2-6 × 1 μm, cylindrical to conical, often forked, obtuse to subacute, pale yellow, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled, composed of *Siccus*-type broom cells; main body 12-18(-25) × 7-14 μm, clavate to broadly clavate, pyriform or irregular in outline, seldom branched, hyaline to pale yellow, inamyloid, thin- to thick-walled; apical setulae 2-3 × 1 μm, conical to cylindrical, subacute to obtuse, yellowish brown to brown, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 4-7(-10) μm diam., regular to interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-5 μm diam., subparallel, cylindrical, brown to dark brown, smooth, dextrinoid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 2-5 μm diam., subparallel, cylindrical, hyaline, smooth, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution. Scattered to gregarious on undetermined dicotyledonous leaves, northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Sangasabhasri Land on the way to Huai Kok Ma Village, N 18° 48.4' E 98° 54.6' alt. 1,146 m., 29 July 2003, N. Wannathes 058 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Pathummikaram temple in Pa Deng Village, 25 August 2003, N. Wannathes 130 (CMU: **holotype**; SFSU: **isotype**); Chiang Mai Province, Doi Inthanon National Park, Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., 3 July 2004, N. Wannathes 200 (CMU, SFSU).

Discussion: *Marasmius cafeyen* is characterized by the following features: small, striate to sulcate, umbilicate pilei colored creamish brown to creamish yellow (coffee with milk coloured) with a darker disc, distant (8-12) collariate lamellae with, non-marginate edges, ellipsoid basidiospores with mean $9.8 \times 4.3 \mu\text{m}$ and mean $Q = 2.3$, and dicotyledonous leaf substrate. The Thai species is most phenetically similar to the following species. *Marasmius gracilichorda* Corner, described from Singapore, differs in forming a brownish orange to reddish brown or dark brown pileus, brown marginate lamellae, and pileipellis broom cells with warted and often forked setulae up to $12 \mu\text{m}$ long (Corner, 1996). *Marasmius pallipes* Singer, described from South America, differs in forming more cinnamon buff to ochraceous buff pileus, a pale stipe (stramineous to light chestnut), and slightly broader basidiospores measuring $4.5\text{-}6.2 \mu\text{m}$ wide with mean diameter near $5 \mu\text{m}$ (Singer, 1976). *Marasmius ruforotula* Singer, described from North America and reported here from Thailand, differs in forming pilei with reddish brown to rusty brown or brownish yellow disc and greyish orange to light yellow margin, orange-marginate lamellae, and broader basidiospores with mean width $5.8 \mu\text{m}$.

17. *Marasmius ruforotula* Singer, Sydowia 2: 34. 1948. (Fig. 21)

Pileus 3-7 mm diam, paraboloid to convex, umbilicate, with a small reddish brown papilla in the umbilicus, striate, dull, dry, glabrous to minutely subvelutinous; disc brownish yellow to pale rusty brown, margin grayish orange (6B4-5) to light yellow (4A4). *Context* thin, cream (3A2). *Lamellae* adnate to a collarium, distant (9-10) with no lamellula,

non-intervenose, broad (0.8-1 mm), cream (3A2) with orange edges. *Stipe* 27-34 \times 0.1-0.2 mm, central to eccentric, cylindrical, terete, wiry, tough, glabrous, insititious, reddish brown (7E6) overall; rhizomorphs absent. *Odor* and *taste* not distinctive.

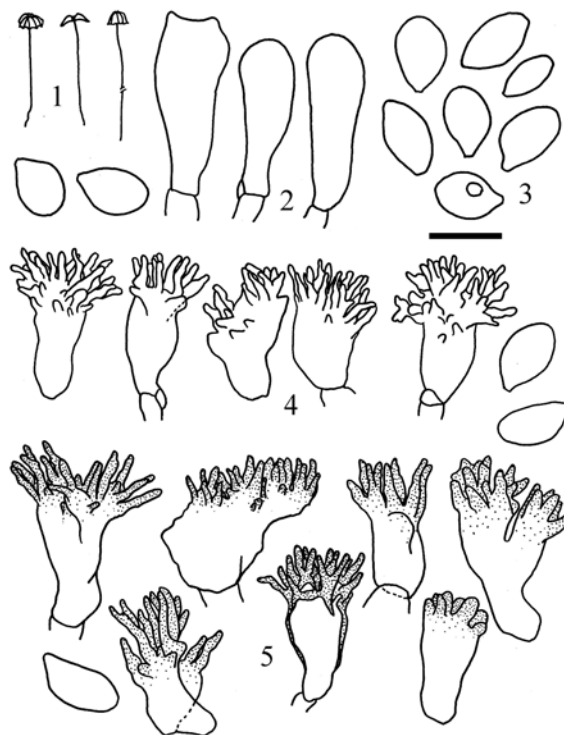


Fig. 21. *Marasmius ruforotula* (N. Wannathes 257). 1. Basidiomes 2. Basidioles and basidium 3. Basidiospores 4. Cheilocystidia 5. Pileipellis, Scale bar 1 = 20 mm, 2-5 = 10 μm

Basidiospores (8-)-10-12 \times (4.5-)-5-7 μm [$x_{mr} = 9.3\text{-}11.1 \times 5.1\text{-}6.5 \mu\text{m}$, $x_{mm} = 10.2 \pm 0.9 \times 5.8 \pm 0.7 \mu\text{m}$, $Q = 1.5\text{-}2.0$, $Q_{mr} = 1.6\text{-}2.0$, $Q_{mm} = 1.8 \pm 0.2$, $n = 25$ spores, $s = 1$ specimen], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* and *basidioles* clavate to cylindrical. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 12-15 \times 6-8 μm , cylindrical to pyriform, clavate or broadly clavate, rarely lobed, hyaline, thin-walled; apical setulae 3-5 \times 0.8-1.0 μm , crowded, cylindrical to conical or wavy, obtuse to subacute, yellow, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled, composed of *Siccus*-type broom cells; main body 14-20 \times 8-14 μm , pyriform to clavate or broadly clavate, sometimes irregular in outline, seldom lobed, pale yellow, inamyloid, thin- to thick-walled; apical setulae (2-)-4-8 \times 1-1.5(-2) μm , cylindrical to conical or irregular in outline,

obtuse to subacute, yellow to yellowish brown or tawny, inamyloid, thick-walled. *Pileus trama* and *lamellar trama* interwoven; hyphae 4-8 μm diam, cylindrical, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-4 μm diam, parallel, cylindrical, smooth, light brown, inamyloid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 2-3 μm diam, parallel, cylindrical, smooth, hyaline, inamyloid, thin-walled. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat, and known distribution: Scattered to gregarious on undetermined dicotyledonous leaves. Florida, Guadeloupe, Mexico, Ecuador, Papua New Guinea, Java, Thailand.

Material examined: Thailand. Chiang Mai Province, New waterfall near 36 km marker on Hwy 1095, 20 Aug. 2004, N. Wannathes 257 (CMU, SFSU).

Discussion: The material from northern Thailand fits within the concept of *M. ruforotula* as it occurs in the old world tropics as reported by Desjardin and Horak (1997) and Desjardin *et al.* (2000) although there are subtle differences. The Thai material has larger basidiospores with mean $10.2 \times 5.8 \mu\text{m}$ versus $8.9 \times 4.3 \mu\text{m}$ from Indonesia. Spore size and other basidiome features match quite closely those reported for *M. gordipes* Sacc. & Paol., a species described from Melaka State, Malaysia. The latter species, however, was characterized as having a reddish brown pileus and an exceptionally long stipe, measuring 60-130 mm, and with *Siccus*-type broom cells that have fewer and more blunt setulae (Pegler 1986).

A tetrapolar mating system was reported for *M. ruforotula* by Wannathes *et al.* (2007) based on Thai specimens.

Section *Globulares* Kühner, Botaniste 25: 100. 1933 (ut *Globularineae*).

Type: *Marasmius globularis* Fr. (= *M. wynneae* Berk. & Broome).

18. *Marasmius calvus* Berk. & Broome, J. Linn. Soc. Bot. 14: 34. 1873 (Figs 22, 30-1)

Pileus 42-87 mm diam., convex to plano-convex, sulcate to plicate, glabrous, dull, greyish orange (5B5) to light brown (6D5) overall. *Context* brownish orange (5C5), thin. *Lamellae* free to narrowly adnexed, subdistant

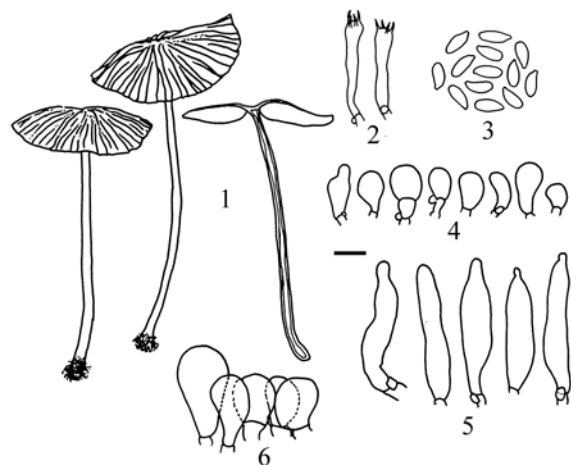


Fig. 22. *Marasmius calvus* (N. Wannathes 331). 1. Basidiomes 2. Basidia 3. Basidiospores 4. Cheilocystidia 5. Pleurocystidia 6. Pileipellis, Scale bar 1 = 10 mm, 2-6 = 10 μm

to close (14-19) with 2-3 series of lamellulae, broad (6-12 mm), brownish orange (5C5), non-marginate, non-intervenose. *Stipe* 82-125 \times 2-5 mm, central, cylindrical with subbulbous base, hollow, glabrous to silky, non-insititious, light brown to buff overall. *Odor* and *taste* not distinctive.

Basidiospores 8-10 \times 3.5-4 μm [$x_m = 8.9 \pm 0.6 \times 3.9 \pm 0.2 \mu\text{m}$, $Q = 2.0-2.7$, $Q_m = 2.3$, $n = 25$ spores, $s = 1$ specimen], narrowly ellipsoid, slightly curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* 25-30 \times 5 μm , cylindrical to clavate, 4-spored. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, 8-14 \times 7-10 μm , broadly clavate to pyriform or irregularly cylindrical, hyaline, inamyloid, thin-walled. *Pleurocystidia* abundant, also scattered along lamellae edge among the cheilocystidia, 36-46 \times 7-10 μm , fusoid to clavate, usually attenuated and strangulate at the apex, hyaline, inamyloid, thin-walled. *Pileipellis* a hymeniform layer of *Globulares*-type cells: 11-28 \times 10-15 μm , clavate to broadly clavate or pyriform, hyaline, inamyloid, thin-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 7-20 μm diam., regular, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-6 μm diam., subparallel, cylindrical, yellow, smooth, weakly dextrinoid, thin-walled, non-gelatinous. *Stipe trama* hyphae 6-9(-11) μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution. Scattered to gregarious on dicotyledonous leaves, Indonesia, northern Thailand and Sri Lanka.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 25 June 2005, N. Wannathes 331 (CMU, SFSU).

Discussion: Diagnostic features of *Marasmius calvus* include a sulcate to plicate, greyish orange to light brown pileus, subdistant (14-19), broad lamellae, a pallid, glabrous stipe, narrowly ellipsoid basidiospores with mean $8.9 \times 3.9 \mu\text{m}$, numerous cheilocystidia and pleurocystidia, and an absence of caulocystidia. The Thai specimen matches the material described from Indonesia and Sri Lanka quite well. Absent from the description of the Indonesian specimen (Desjardin *et al.*, 2000) are the sterile lamellae edge composed of short, broadly clavate cheilocystidia as reported herein. Re-examination of Retnowati 145 (SFSU) confirmed their presence. *Marasmius calvus* is the only known member of sect. *Globulares* from Thailand that forms distinct pleurocystidia.

19. *Marasmius albimyceliosus* Corner, Beih. Nova. Hedwigia. 111: 28. 1996

(Figs 23, 30-2)

Pileus 15-38 mm diam., convex when young, plano-convex to plano-concave and subumbilicate in age, reticulate, glabrous, dull, disc and striae brown, elsewhere pale cream to grayish brown. *Context* light brownish cream, thin. *Lamellae* adnate, subdistant (12-16) with 3-4 series of lamellulae, narrow (2-3 mm), cream, non-marginate, strong intervenose to poroid-reticulate. *Stipe* 23-53 \times 1-4 mm, central, cylindrical or tapering downward to a subbulbous base, hollow, glabrous, non-insititious, apex light greyish brown, base brown to reddish brown. *Odor* and *taste* not distinctive.

Basidiospores 6-7(-8) \times (3-)3.5-4(-4.5) μm [$x_m = 6.8 \pm 0.5 \times 4 \pm 0.3 \mu\text{m}$, $Q = 1.5 - 2.0$, $Q_m = 1.7$, $n = 25$ spores, $s = 1$ specimen], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* cylindrical. *Cheilocystidia* poorly differentiated,

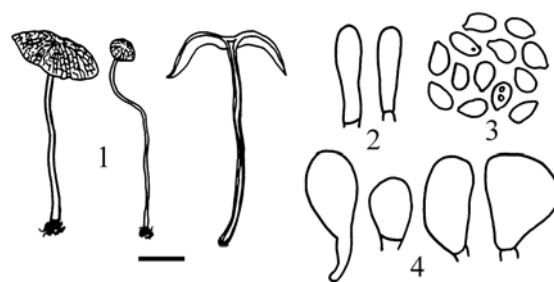


Fig. 23. *Marasmius albimyceliosus* (N. Wannathes 422). 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Pileipellis, Scale bar 1 = 10 mm, 2-4 = 10 μm

basidiole-like, clavate cells. *Pleurocystidia* absent. *Pileipellis* a hymeniform layer of *Globulares*-type cells: 15-30 \times 9-18 μm , clavate to broadly clavate or pyriform, hyaline to light brown, inamyloid, thin-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 4-10 (-16) μm diam., regular to interwoven, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 4-8 μm diam., subparallel, cylindrical, brown to dark brown, smooth, inamyloid, thick-walled (up to 2 μm), non-gelatinous. *Stipe trama* hyphae 7-12 μm diam., subparallel, cylindrical, pale yellow to yellow, smooth, inamyloid, thin- to slightly thick-walled (up to 0.5 μm), non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Solitary on dicotyledonous leaves, northern Thailand and Singapore.

Material examined: Thailand. Phrae Province, Muang District, Pa Dang, Nong Cham Village, 18 August 2005, N. Wannathes 422 (CMU, SFSU).

Discussion: *Marasmius albimyceliosus* is distinguished by a reticulate, pale cream to greyish brown pileus with darker disc and striae, subdistant, poroid-reticulate lamellae, a glabrous, brown to reddish brown stipe, small basidiospores with mean $6.8 \times 4 \mu\text{m}$, poorly differentiated cheilocystidia, and an absence of pleurocystidia and caulocystidia. The Thai material matches quite well with the protologue based on specimens collected from Singapore (Corner, 1996). *Marasmius albimyceliosus* is similar to *M. cohortalis* Berk. described from South America, but the latter differs in forming well differentiated, subglobose to pyriform cheilocystidia.

20. *Marasmius pellucidus* Berk. & Broome, J. Linn. Soc., Bot. 14: 35. 1873. (Figs 24, 30-3)

= *Cantharellus elegans* Berk. & Broome, J. Linn. Soc., Bot. 14: 33. 1873.

= *Marasmius papyraceus* Masee, Bull. Misc. Inform. 10: 358. 1914.

Pileus 15-50(-98) mm diam, obtusely conical to convex or campanulate when young, expanding to broadly convex, broadly campanulate, plano-campanulate or nearly plane in age, often with a shallow central depression; disc smooth to rugulose or reticulate; margin striate to rugulose-striate or rugulose-sulcate, pellucid, initially decurved, in age decurved to upturned, wavy or undulate; surface hygrophalous, glabrous, moist to dry, dull; disc ivory, cream (4A3), pale orange white (5A2-3), or pale brownish grey (6C3); margin white, ivory, buff, pale yellowish white (4A2) or cream (4A3), in age entire pileus often dingy white and pellucid. *Context* thin (0.5-1 mm), pliant, white. *Lamellae* adnate to shallowly adnexed, non-collariate, close to subdistant or distant (12-20(-26)) with 3-5 series of lamellulae, narrow (0.5-2 mm, rarely up to 4 mm broad), sometimes not reaching pileus margin, often anastomosing and intervenose, white to ivory, pale yellowish white (4A2) or cream (4A3); edges even, non-marginate. *Stipe* (20-)40-112 × (1-)2-3 mm, central, terete or sometimes once-cleft, ±equal, sometimes wavy, cartilaginous or pliant, tough, fistulose, sometimes twisted-fibrous, dull, dry, apex minutely pruinose, base pruinose or furfuraceous to appressed-fibrillose, non-insititious, arising from dense creamy white mycelium; apex white to pale yellowish white (4A2), centrally greyish orange (5B4), brownish yellow (5C5-6) or brownish orange (6C5-7), base brown (7D-E5-8), reddish brown (8D-E4-8), or dark brown (7-8F5-8). *Odor* mild, somewhat sweet, like *Marasmius oreades*. *Taste* not distinctive.

Basidiospores (6-)6.5-8(-8.5) × (2.5-)3-4 μm [$x_{mr} = 6.9-7.3 \times 3-3.6 \mu\text{m}$, $x_{mm} = 7.1 \pm 0.1 \times 3.4 \pm 0.2 \mu\text{m}$, $Q_{mr} = 1.7-2.3$, $Q_{mm} = 2.1 \pm 0.2$, $n = 20-25$ spores, $s = 11$ specimens], subfusoid to ellipsoid or amygdaliform, with a prominent hilar appendix, smooth, hyaline, inamyloid, thin-walled. *Basidia* 16-30 × 4.5-7 μm, clavate, 4-spored. *Basidioles* clavate to subfusoid. *Cheilocystidia* abundant, lamellar edge sterile,

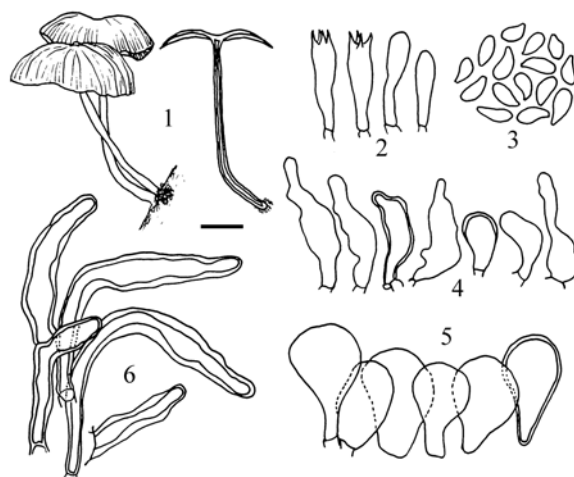


Fig. 24. *Marasmius pellucidus* (N. Wannathes 022). 1. Basidiomes 2. Basidia and basidioles 3. Basidiospores 4. Cheilocystidia 5. Pileipellis 6. Caulocystidia, Scale bar 1 = 10 mm, 2-6 = 10 μm

12-30(-40) × 4.5-8(-12) μm, versiform, ranging from irregularly cylindrical to fusoid, ventricose, clavate or boot-shaped, hyaline, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* a hymeniform layer of *Globulares*-type cells: cells 10-25(-32) × (6-)8-18(-25) μm, subglobose to pyriform, clavate or broadly clavate, sometimes in short chains, hyaline, inamyloid, thin-walled; arising from a subcutis up to 30 μm thick formed of irregularly isodiametric or puzzle-shaped cells 5-12 μm diam that are tightly packed, dextrinoid, thin-walled. *Pileus trama* of loosely interwoven hyphae 2.5-8(-12) μm diam, cylindrical to irregularly cylindrical, thin-walled or thick-walled (up to 0.5 μm), hyaline, dextrinoid, non-gelatinous. *Lamellar trama* regular; hyphae 2.5-10 μm diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 5-10 μm diam, parallel, cylindrical, smooth, non-incrusted, yellow to tawny in H₂O, pale yellowish green in 3%KOH, strongly dextrinoid, thick-walled (up to 0.5 μm), non-gelatinous. *Stipe trama* hyphae 5-16(-20) μm diam, subparallel, cylindrical, hyaline, dextrinoid thin-walled. *Caulocystidia* 15-60(-85) × (4-)6-14 μm, versiform, ranging from irregularly cylindrical to fusoid, ventricose, clavate or irregular in outline, sometimes geniculate, hyaline, inamyloid to dextrinoid, thin-walled to thick-walled (0.5-1.5 μm). *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Gregarious to densely gregarious, typically in

cespitate clusters on leaf mulch or on woody debris or rotten logs of various dicotyledonous plants, sometimes amongst bamboo leaves. Borneo, Java, Malaysia, New Caledonia, Singapore, Sri Lanka and Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Inthanon National Park, Mae Chem jct., elev. 1600 m, N18°31.420', E98°29.216', 26 June 2003, N. Wannathes 007 (CMU, SFSU); Chiang Mai Province, Pathummikaram temple on Hwy 1095, 13 Jul. 2003, N. Wannathes 022 (CMU, SFSU); Chiang Mai Province, Mushroom Research Centre, 27 km marker on Hwy 1095, 2 Jul. 2003, N. Wannathes 016 (CMU, SFSU); Chiang Mai Province, Doi Suthep National Park, Sangra Sabhasri Lane to Huai Kok Ma Village, elev. 1145 m, N18°48.402', E98°54.617', 14 Aug. 2003, N. Wannathes 109 (CMU, SFSU); same location, 24 June 2005, N. Wannathes 321 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Mae Sae Village, Pang Sa Ded Water Conservation Area, N 19° 14.6', E 98° 38.5' alt. 962 m., 26 June 2005, N. Wannathes 342 (CMU, SFSU); Doi Inthanon National Park, Mae Chem jct., elev. 1600 m, N18°31.420', E98°29.216', 27 June 2005, N. Wannathes 352 (CMU, SFSU).

Discussion: *Marasmius pellucidus* is recognized easily in the field because of its relatively large, paper-thin, white, pellucid-striate pileus, very narrow and intervenose lamellae, and cespitose, reddish brown to brown stipes. It forms large, dense clusters on leaf mulch, woody debris or on rotten logs. Microscopically, diagnostic features include: a hymeniform pileipellis of subglobose to broadly clavate, non-setulose cells; versiform, non-setulose cheilocystidia and caulocystidia; a lack of pleurocystidia; relatively small, subfusoid basidiospores; and dextrinoid tissues. Collectively, these characters indicate that *M. pellucidus* belongs in sect. *Globulares*, where it is allied with a number of species from Africa and South America. A redescription of *M. pellucidus* based on examination of the type specimens of *M. pellucidus*, *M. papyraceus* and *C. elegans*, plus numerous newly collected specimens throughout Southeast Asia was published by Wannathes *et al.* (2004).

21. *Marasmius mokfaensis* Wannathes, Desjardin & Lumyong, Fungal Diversity 36: 160. 2009. (Figs 25, 30-4)
MycoBank: MB511934

Pileus 30-90 mm diam., obtusely conical when young, convex to campanulate in age, dull, dry, glabrous, rugulose-plicate, hygrophorous, blackish blue (19F4-6) to purplish

grey (14F3-4) or dark brown to dark greyish brown (7-9F3-5) overall when young, becoming greyish magenta (14D3) to pale brownish grey (8-9D-E3) on disc and plicae in age with the ridges paler to pale greyish brown (10E3) or pale violet brown. *Context* pale greyish white to white, thin. *Lamellae* subfree to adnexed, distant (13-18) with 0-1 series of lamellulae, broad (4-10 mm), greyish white (9B1) to grey (9C-D2), greyish magenta (14D3) or brownish grey (8D2), non-marginate, non-intervenose. *Stipe* 85-180 × 3-7 mm, central, cylindrical with a narrowly clavate base, twisted-fibrous,



Fig. 25. *Marasmius mokfaensis* (D.E. Desjardin 7726). 1. Basidiomes 2. Basidia 3. Cheilocystidia 4. Pileipellis 5. Basidiospores, Scale bar 1 = 10 mm, 2-6 = 10 μ m

hollow, glabrous, base tomentose, apex greyish violet (17D4-6) to greyish white, base greyish yellow (4B3-4) to brownish grey (6-8D2-3); stipe context yellow in age. *Odor* faintly raphanoid to rancid. *Taste* unpleasant.

Basidiospores 27-33 × 5-6 μ m [x_{mr} = 28.6-30.7 × 5.0-5.6 μ m, x_{mm} = 30.0 ± 1.0 × 5.3 ± 0.3 μ m, Q = 4.7-6.6, Q_{mm} = 5.7 ± 0.2, Q_{mr} = 5.5-5.9, n = 25 spores, s = 4 specimens], clavate to subfusoid, often curved in profile, hyaline, inamyloid, thin-walled. *Basidia* 41-45 × 11-12 μ m, clavate, 4-spored. *Basidioles* cylindrical to clavate. *Cheilocystidia* common, 15-33 × (3-)5-11(-17) μ m, irregularly clavate to ventricose, hyaline, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* a hymeniform layer of *Globulares*-type cells, 11-31(-39) × 7-15 μ m, clavate to broadly clavate or pyriform, hyaline, inamyloid, thin-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 4-8 μ m diam., interwoven, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 5-

15 µm diam., parallel, cylindrical, smooth, brown to dark greenish brown, inamyloid to weakly dextrinoid, thin- to thick-walled (up to 1 µm), non-gelatinous. *Stipe trama* hyphae 3-8 µm diam., parallel, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Solitary on bamboo and dicotyledonous leaves, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.581', E98°46.353', 1014 m alt., 28 June 2003, D.E. Desjardin 7592 (CMU, SFSU); same location, 3 July 2003, D. E. Desjardin 7606 (CMU, SFSU); same location, 8 July 2003, N. Wannathes 020 (CMU, SFSU); same location, 29 June 2004, D.E. Desjardin 7726 (CMU: **holotype**; SFSU: **isotype**); same location, 25 June 2005, N. Wannathes 328 (CMU, SFSU).

Discussion: Diagnostic features of *Marasmius mokfaensis* include: a very large, plicate pileus 30-90 mm diam., colored blackish blue to purplish grey with paler ridges; distant, broad greyish brown lamellae; a large (85-180 × 3-7 mm), pale colored stipe; clavate basidiospores with mean 30 × 5.3 µm and mean $Q = 5.7$; irregularly clavate to ventricose cheilocystidia, and absence of pleurocystidia and caulocystidia. This is the largest known *Marasmius* in Thailand and is phenetically similar to two large African species. *Marasmius zenkeri* Henn. differs in forming pilei with more lilac-violet to lilac-pink pilei, smaller basidiospores (15.5-27 × 4.2-5.6 µm with mean $Q = 4.0$), and more consistently clavate cheilocystidia (Antonín 2007). *Marasmius bekolacongoli* Beeli differs in forming pilei that in age have dull red to greyish red disc and sulcae with yellowish white to lemon yellow ridges, smaller basidiospores (17.5-26 × 3.8-5.4 µm with mean $Q = 4.8$), and more consistently clavate cheilocystidia (Antonín 2007).

22. *Marasmius purpureostriatus* Hongo, J. Jap. Bot. 33: 344. 1958. (Figs 26, 30-8)

Pileus 13-20 mm diam., obtusely conical to convex with a small rugulose umbo, sulcate to plicate, glabrous, dull, striped, disc dark violet (18F8), sulcae greyish violet (18E6), greyish yellow (2B4) elsewhere. *Context* greyish violet (18E6), thin. *Lamellae* adnexed,

subdistant (9-13) with 0-1 series of lamellulae, broad (1-3 mm), pale yellow (2A3), non-marginate, non-intervenose. *Stipe* 52-103 × 0.5-1.5 mm, central, cylindrical with or without a subbulbous base, hollow, glabrous, non-insititious, apex purplish grey (16D2), base brown to reddish brown (E8E). *Odor* and *taste* not distinctive.

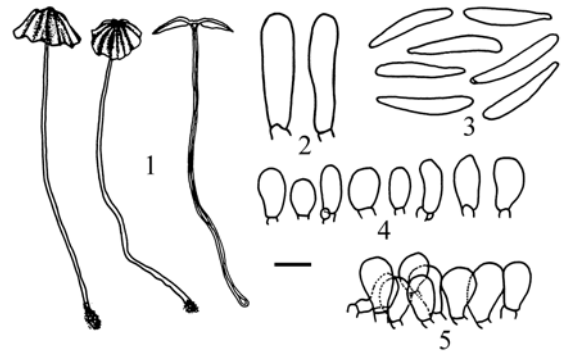


Fig. 26. *Marasmius purpureostriatus* (N. Wannathes 318). 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5. Pileipellis, Scale bar 1 = 10 mm, 2-6 = 10 µm

Basidiospores (19-)21-30 × (4-)5-6(-7) µm [$x_{mr} = 21.3-28.2 \times 4.6-6.2 \mu\text{m}$, $x_{mm} = 23.8 \pm 3.9 \times 5.3 \pm 0.8 \mu\text{m}$, $Q_{mr} = 3.6-6.2$, $Q_{mm} = 4.7$, $n = 25$ spores, $s = 8$ specimens], clavate to fusoid, often curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* clavate to cylindrical. *Cheilocystidia* abundant, 10-31 × 7-15 µm, cylindrical to broadly clavate or pyriform, hyaline, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* a hymeniform layer of *Globulares*-type cells, 12-27 × 8-14 µm, broadly clavate to pyriform, hyaline to light brown, inamyloid, thin- to thick-walled (up to 0.5 µm). *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 3-10(-16) µm diam., interwoven, cylindrical to inflated, smooth, hyaline, dextrinoid, thin- to thick-walled (up to 1.5 µm), non-gelatinous. *Stipitipellis* hyphae 4-11 µm diam., subparallel to parallel, cylindrical, yellowish brown to light brown, smooth, weakly dextrinoid to inamyloid, thin- to thick-walled (up to 1µm), non-gelatinous. *Stipe trama* hyphae 3-8(-12) µm diam., subparallel, cylindrical, hyaline, smooth, dextrinoid to weakly dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Solitary to gregarious on dicotyledonous leaves,

Japan, Malaysia, Thailand and Papua New Guinea.

Material examined: Thailand. Chiang Mai Province, Mae Taeng District, Tung Joaw Village, N 19° 8.07' E 98° 38.9' alt. 1423 m., 13 June 2004, N. Wannathes 158 (CMU, SFSU), Chiang Mai Province, Doi Suthep-Pui National Park, Medicinal Plant garden, 16 June 2005, N. Wannathes 317 and 318 (CMU, SFSU), Chiang Mai Province, Doi Inthanon National Park, At 25 km marker on Highway 1,009, N 18° 32.5' E 98° 33.5' alt. 1,076 m. 27 June 2005, N. Wannathes 363 (CMU, SFSU).

Discussion: *Marasmius purpureostriatus* is distinguished by a relatively large, plicate and striped pileus with greyish violet disc and plicae and greyish yellow ridges, subdistant, broad lamellae, a purplish grey to reddish brown stipe, large clavate basidiospores with mean range of $21.3\text{--}28.2 \times 4.6\text{--}6.2 \mu\text{m}$, and an absence of pleurocystidia and caulocystidia. The Thai material matches quite closely with the descriptions of specimens collected from Papua New Guinea (Desjardin & Horak, 1997) except that the Thai specimens formed smaller basidiomes (pilei 13–20 mm diam. vs 15–50 mm diam.).

23. *Marasmius pseudopurpureostriatus*
Wannathes, Desjardin & Lumyong, Fungal Diversity 36: 162. 2009. (Figs 27, 30–36)
MycoBank: MB511935

Pileus 14–38 mm broad, convex to depressed, dull, glabrous, plicate, disc and plicae dark purple (14F5) to dark magenta (13F7), striped with pale yellow (3A3) to greyish yellow (4B4) ridges. *Context* greyish yellow (4B4), thin. *Lamellae* adnexed, distant (9–11) with 0–1 series of lamellulae, narrow, greyish yellow (4B4), non-marginate, non-intervenose. *Stipe* 62–80 \times 1.5–3 mm, central, cylindrical to tapering upwards, hollow, glabrous, non-insititious, apex greyish magenta (14E5), base brown (7E7). *Odor* and *taste* not distinctive.

Basidiospores $20\text{--}25 \times 5\text{--}6.2 \mu\text{m}$ [$x_m = 22.8 \pm 2.4 \times 5.6 \pm 0.6$, $Q = 3.9\text{--}4.4$, $Q_m = 4.1$, $n = 4$ spores, $s = 1$ specimen], clavate to subfusoid, often curved in profile, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* cylindrical to clavate. *Cheilocystidia* common, $12\text{--}25 \times 6\text{--}12 \mu\text{m}$, clavate to broadly clavate, hyaline, inamyloid, thin-walled.

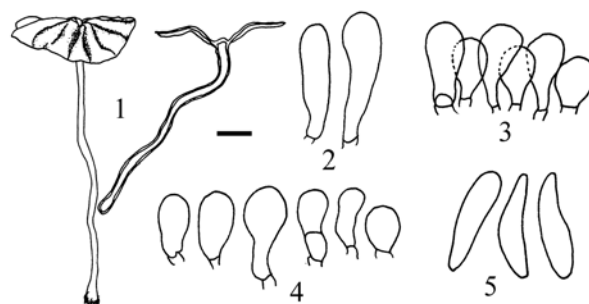


Fig. 27. *Marasmius pseudopurpureostriatus* (N. Wannathes 286). 1. Basidiomes 2. Basidioles 3. Pileipellis 4. Cheilocystidia 5. Basidiospores, Scale bar 1 = 10 mm, 2–6 = 10 μm

Pleurocystidia absent. *Pileipellis* a hymeniform layer of *Globulares*-type cells, $14\text{--}23 \times 10\text{--}11 \mu\text{m}$, clavate to broadly clavate, hyaline, inamyloid, thin- to thick-walled (up to $1 \mu\text{m}$). *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae $4\text{--}10 \mu\text{m}$ diam., interwoven, cylindrical to inflated, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae (3–) $5\text{--}10 \mu\text{m}$ diam., subparallel, cylindrical, brown to light brown, smooth, dextrinoid, thin- to thick-walled (up to $1 \mu\text{m}$), non-gelatinous. *Stipe trama* hyphae $5\text{--}12 \mu\text{m}$ diam., subparallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, Northern Thailand.

Material examined: Thailand, Chiang Rai Province, Weing Papoa District, Khun Chae National Park, N19°4.405', E99°23.543', 963 m alt., 10 June 2005, N. Wannathes 286 (CMU: **holotype**; SFSU: **isotype**).

Discussion: Basidiomes of *Marasmius pseudopurpureostriatus* look like a robust form of *M. purpureostriatus* Hongo, and the two species may be confused in the field. *M. purpureostriatus* differs from the new species in forming smaller pilei (13–20 mm diam.) with darker violet disc and plicae and more whitish ridges, has a thinner stipe (< 1.5 mm), and slightly longer basidiospores ($21\text{--}30 \mu\text{m}$ with mean length about $24 \mu\text{m}$). *Marasmius pseudopurpureostriatus* is also similar to *M. bekolacongoli*, a species widespread in tropical Africa, but the latter differs in forming pilei that are violaceous brown to dull red or greyish red with lemon yellow stripes, and a much larger stipe ($50\text{--}150 \times 2.5\text{--}10$ mm).

24. *Marasmius grandiviridis* Wannathes, Desjardin & Lumyong, Fungal Diversity 36: 156. 2009. (Figs 28, 30-7)
MycoBank: MB511932

Pileus 37-88 mm diam., conical to hemispherical when young, broadly conical with a slight depression in age, glabrous, dull, plicate, yellowish green with olive green plicae. *Context* yellowish green, thin. *Lamellae* narrowly adnate, distant (10-13) with 1 series of lamellulae, broad (2-9 mm), yellowish green,

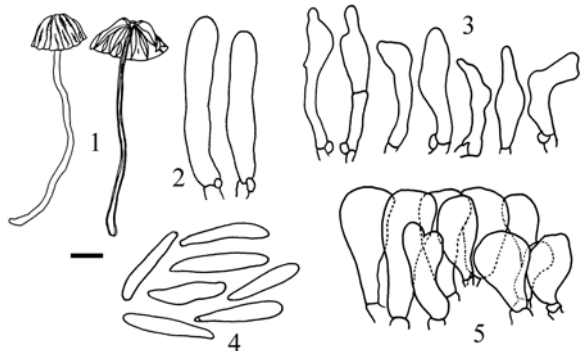


Fig. 28. *Marasmius grandiviridis* (N. Wannathes 152). 1. Basidiomes 2. Basidioles 3. Cheilocystidia 4. Basidiospores 5. Pileipellis, Scale bar 1 = 10 mm, 2-6 = 10 μ m

non-marginate, non-intervenose. *Stipe* 133-180 \times 3-7 mm, central, cylindrical, hollow, glabrous, non-insititious, apex yellowish light brown, base brownish green to brown. *Odor* and *taste* not distinctive.

Basidiospores (23-)26-30 \times 4-5 μ m [$x_m = 26.7 \pm 1.9 \times 4.4 \pm 0.5 \mu$ m, $Q = 4.6-7.5$, $Q_m = 6.1$, $n = 25$ spores, $s = 1$ specimen], clavate to subfusoid, often curve in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* cylindrical to clavate. *Cheilocystidia* abundant, lamellae edge sterile, 18-43 \times 5-12 μ m, irregularly cylindrical to clavate, lageniform with a broad mucro, rarely forked, hyaline, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* a hymeniform layer of *Globulares*-type cells, 15-42 \times 11-15 μ m, clavate to broadly clavate or pyriform, hyaline to pale yellow, inamyloid, thin-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae (3-) 5-10 μ m diam., regular to interwoven, cylindrical to inflated, smooth, hyaline, weakly dextrinoid to inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 4-8 (-10) μ m diam., subparallel, cylindrical, yellow to greenish yellow, smooth, weakly dextrinoid

to dextrinoid, thick-walled (up to 2 μ m), non-gelatinous. *Stipe trama* hyphae 4-12 μ m diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves; Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Inthanon National Park, junction of Hwy 1009 and road to Mae Chem, N19°31.58', E 98°29.64', 1700 m alt., 10 June 2004, N. Wannathes 152 (CMU: **holotype**; SFSU: **isotype**); same location, 27 June 2005, N. Wannathes 349 (CMU, SFSU).

Discussion: Distinctive features of *M. grandiviridis* include a large, plicate pileus (37-88 mm diam) colored yellowish green with darker olive-green plicae, yellowish green, distant (10-13) lamellae, a large (133-180 \times 3-7 mm), yellow to brownish green, glabrous stipe, clavate basidiospores with mean 26.7 \times 4.4 μ m, irregularly clavate to lageniform-mucronate cheilocystidia, and an absence of pleurocystidia and caulocystidia. It is similar to *M. viridis* Desjardin & E. Horak, described from Papua New Guinea, but the latter differs in forming smaller basidiomes (pilei 10-15 mm diam, stipe 30-50 \times 1 mm) with more lamellae (12-16), a dark reddish brown stipe, smaller basidiospores (20-25 \times 4-5 μ m) and cheilocystidia that are more regularly clavate (Desjardin & Horak 1997).

25. *Marasmius laticlavatus* Wannathes, Desjardin & Lumyong, Fungal Diversity 36: 158. 2009. (Figs 29, 30-5)
MycoBank: MB511933

Pileus 15-19(-33) mm diam., convex to plano-convex or plano-infundibuliform with a wrinkled umbo, dull, glabrous, sulcate to plicate, disc brown, margin yellowish grey to greyish cream. *Context* greyish yellow, thin. *Lamellae* adnexed to adnate, distant (10-13) with 1-2 series of lamellulae, broad (2-6 mm), buff to cream or white, non-marginate, non-intervenose. *Stipe* 30-80 \times 1-2 mm, central, cylindrical with a narrow subbulbous at base, hollow, glabrous, apex yellowish grey to buff, base brownish orange to reddish brown. *Odor* and *taste* not distinctive.

Basidiospores 26-35 \times 5-6(-7) μ m [$x_{mr} = 28.7-32 \times 5.1-6 \mu$ m, $x_{mm} = 30.4 \pm 1.9 \times 5.6 \pm$

0.5 μm , $Q = 4.1-6.9$, $Q_{\text{mr}} = 5.0-6.0$, $Q_{\text{mm}} = 5.5 \pm 0.5$, $n = 25$ spores, $s = 4$ specimens], clavate to subfusoid, often curved in profile, hyaline, inamyloid, thin-walled. *Basidia* not observed.

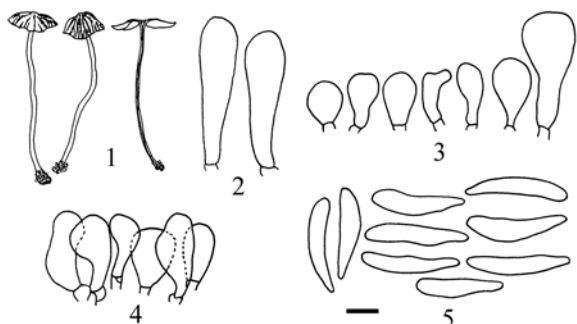


Fig. 29. *Marasmius laticlavatus* (N. Wannathes 231). 1. Basidiomes 2. Basidioles 3. Cheilocystidia 4. Pileipellis 5. Basidiospores, Scale bar 1 = 10 mm, 2-6 = 10 μm

Basidioles cylindrical to clavate. *Cheilocystidia* abundant, $13-30 \times 9-16 \mu\text{m}$, clavate to broadly clavate, hyaline, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* a hymeniform layer of *Globulares*-type cells, $15-33 \times 9-17(-23) \mu\text{m}$, broadly clavate to pyriform, hyaline, inamyloid, thin-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae $3-10 \mu\text{m}$ diam., interwoven, cylindrical, smooth, hyaline, weakly dextrinoid to dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae $3-8 \mu\text{m}$ diam., subparallel, cylindrical, smooth, yellow to light brown, dextrinoid, thick-walled (up to $2 \mu\text{m}$), non-gelatinous. *Stipe trama* hyphae $5-10 \mu\text{m}$ diam., parallel, cylindrical, smooth, hyaline, weakly dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on bamboo or dicotyledonous leaves, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, 22 km marker on Hwy 1095, $N19^{\circ}07.57'$, $E98^{\circ}45.65'$, 750 m alt., 5 July 2004, T. Y. Shin 312 (CMU, SFSU); Chiang Mai Province, Mae Rim District, Huai Tung Taow Reservoir, 23 July 2004, N. Wannathes 231 (CMU: **holotype**; SFSU: **isotype**); Chiang Rai Province, Muang District, Pong Prabath Waterfall, 11 June 2005, N. Wannathes 293 (CMU, SFSU); Phrae Province, Muang District, Cherng Thong Waterfall, 16 August 2005, N. Wannathes 412 (CMU, SFSU).

Discussion: The new Thai species is characterized by the following features: relatively small, plicate pilei with brown disc and pallid greyish cream margin; distant, cream-colored lamellae; a thin, glabrous stipe colored yellowish grey on the apex and reddish brown at the base; large clavate basidiospores with mean $30.4 \times 5.6 \mu\text{m}$ and mean $Q = 5.5$; broadly clavate cheilocystidia; and an absence of pleurocystidia and caulocystidia. *Marasmius laticlavatus* is most phenetically similar to several pale-colored African species that also lack pleurocystidia, as recently documented by Antonín (2007) *Marasmius camerunensis* Antonín & Mossebo differs in forming much larger pilei ($40-70 \mu\text{m}$ diam.) with violaceous brown disc, broader lamellae ($8-10 \text{mm}$), a much thicker stipe ($4-6 \text{mm}$), smaller basidiospores ($21-30 \times 5.5-6.5 \mu\text{m}$ with mean $Q = 4.2$), and growth on wood. *Marasmius tshopoensis* Antonín differs in forming larger pilei (up to 60mm diam.), strongly intervenose lamellae, smaller basidiospores ($19-26 \times 4.8-6 \mu\text{m}$ with mean $Q = 4.3$), and variably-shaped cheilocystidia some of which may be irregularly lobed, but not consistently broadly clavate. *Marasmius brunneolus* (Beeli) Singer differs in forming larger pilei ($30-80 \text{mm}$ diam.) that are more evenly pigmented brown to reddish brown or striped white, a larger stipe ($70-180 \times 3-6 \text{mm}$), and smaller basidiospores ($15.5-25.5 \times 3.8-5.4 \mu\text{m}$ with mean $Q = 4.5$).

Section *Neosessiles* Singer, *Mycologia* 50: 104. 1958.

Type: *Marasmius neosessilis* Singer.

26. *Marasmius tenuissimus* (Jungh.) Singer, Fl. Neotrop. Monogr. 17: 258. 1976.

(Figs 31, 38-1)

= *Agaricus tenuissimus* Jungh., Verh. Batav. Genootsch. 17: 84. 1838.

= *Marasmius rufescens* Berk. & Broome, J. Linn. Soc. Bot. 14: 41. 1873.

= *Xerotus tener* Berk. & Broome, J. Linn. Soc. Bot. 14: 45. 1873.

= *Marasmius campanella* Holterm., Mykol. Unters. Tropen: 105. 1898.

= *Marasmius campanella* var. *rufescens* (Berk. & Br.) Petch apud Petch, in & Bisby, Peradeniya Manual 6: 59. 1950.

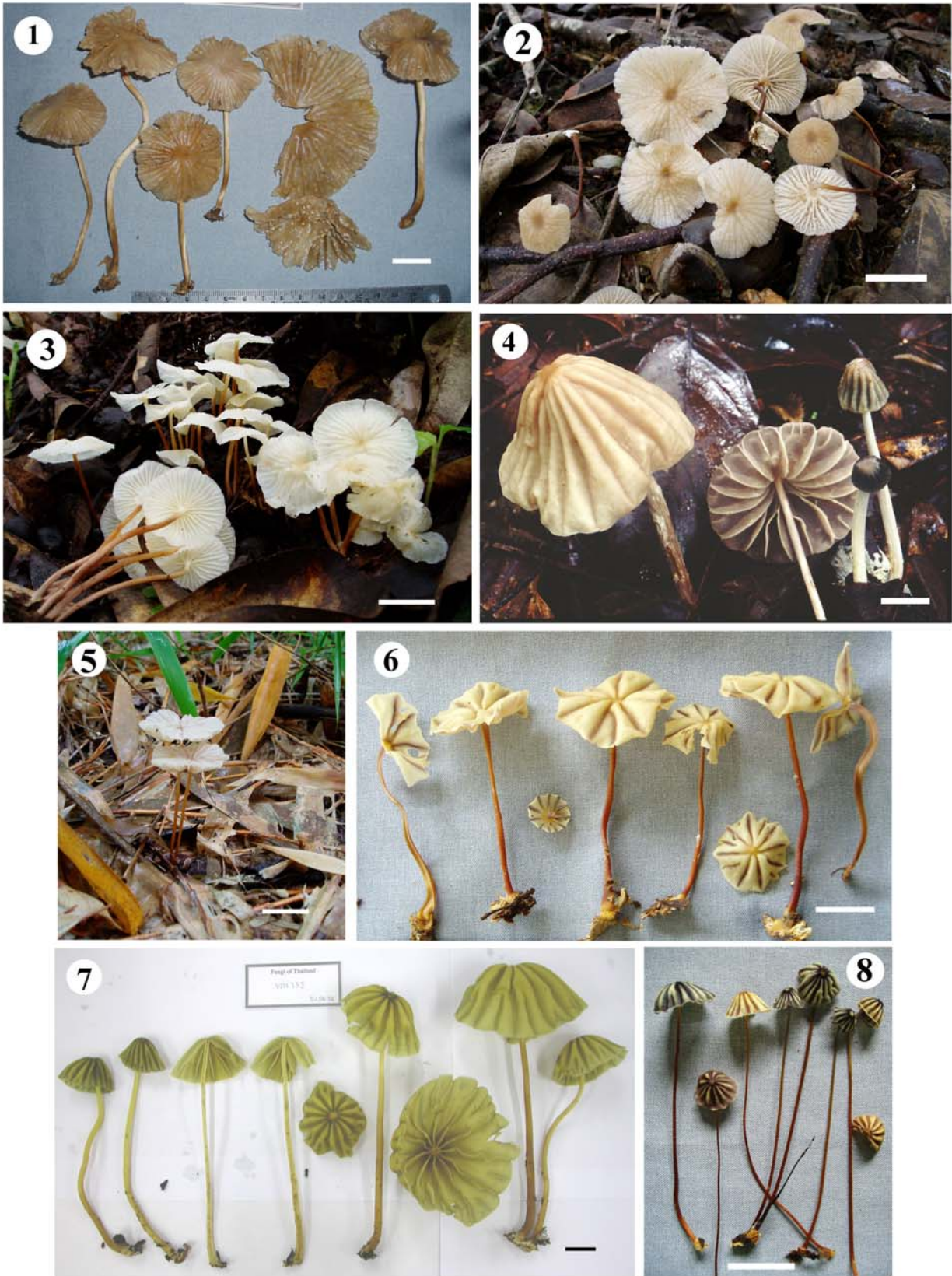


Fig. 30. Basidiomata of *Marasmius* section *Globulares*. 1. *M. calvus* (N. Wannathes 331) 2. *M. albimyceliosus* (N. Wannathes 422) 3. *M. pellucidus* (N. Wannathes 321) 4. *M. mokfaensis* (D.E. Desjardin 7726) 5. *M. laticlavatus* (N. Wannathes 412) 6. *M. pseudopurpureostriatus* (N. Wannathes 286) 7. *M. grandiviridis* (N. Wannathes 152) 8. *M. purpureostriatus* (N. Wannathes 318), Scale bars = 20 mm

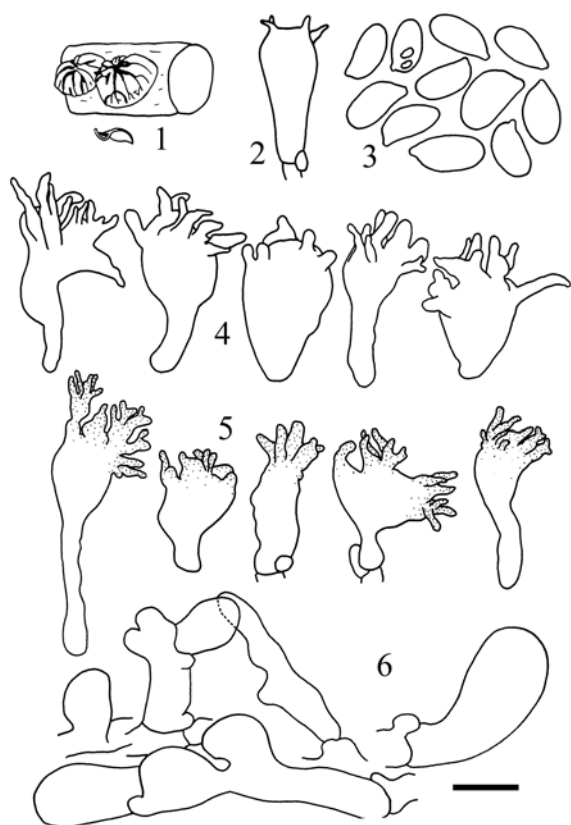


Fig. 31. *Marasmius tenuissimus* (N. Wannathes 199). 1. Basidiomes 2. Basidium 3. Basidiospores 4. Cheilocystidia 5. Pileipellis 6. Caulocystidia, Scale bar 1 = 20 mm, 2-6 = 10 μ m

Pileus 7-22 mm diam., convex to plano-convex, striate to sulcate, often subreticulate, glabrous, dull to shiny, greyish orange (6B5) to golden brown (6C5) or light brown (6D5). *Context* cream, thin. *Lamellae* adnate, remote (5-9) with 0-1 series of lamellulae, narrow, reticulate, intervenose, cream, non-marginate. *Stipe* 0.5-4 \times 0.3-1 mm, eccentric to sublateral, cylindrical to tapering downwards, hollow, pubescent to velutinous, insititious, dark brown (7F4) overall. *Odor* and *taste* not distinctive.

Basidiospores (7-9-10(-12) \times 4-6(-7) μ m [x_{mr} = 8.1-10.1 \times 4.5-6.1 μ m, x_{mm} = 9.4 \pm 0.8 \times 5.3 \pm 0.6 μ m, Q_{mr} = 1.7-1.9, Q_{mm} = 1.8 \pm 0.1, n = 25 spores, s = 5 specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 22-40 \times 8-11 μ m, cylindrical to clavate, 4-spored. *Basidioles* cylindrical to clavate. *Cheilocystidia* of *Siccus*-type broom cells; main body 11-25 \times 5-14 μ m, cylindrical to clavate or pyriform, hyaline, inamyloid, thin-walled; apical setulae 3-8 \times 1-2 μ m, conical to

cylindrical, obtuse to subacute, hyaline, thin-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 13-28(-35) \times 7-11 μ m, clavate to broadly clavate or pyriform, usually forked at apex, yellow to hyaline, inamyloid, thin- to thick-walled; apical setulae 3-7 \times 1-1.5 μ m, conical to cylindrical, obtuse to subacute, yellow to light brown, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 3-7 μ m diam., interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 4-9 μ m diam., subparallel, cylindrical, brown to yellowish brown, smooth, inamyloid, thin- to thick-walled (up to 2 μ m), non-gelatinous. *Stipe trama* hyphae 3-6(-8) μ m diam., subparallel, cylindrical, hyaline to pale yellow, smooth, dextrinoid, thick-walled (up to 2 μ m), non-gelatinous. *Caulocystidia* common, 27-100 \times 5-12 μ m, cylindrical to clavate or irregular in outline, often apically branched, hyaline to pale yellow, inamyloid, thin- to thick-walled. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Gregarious to densely gregarious, typically in caespitose clusters on wood, Malaysia, Northern Thailand and South America (the latter reported by Singer, 1976).

Material examined: Thailand. Chiang Mai Province, Mushroom Research Centre, 27 km marker on Hwy 1095, 28 July 2003, N. Wannathes 050 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Tung Joaw Village, N 19° 8.07' E 98° 38.9' alt. 1423 m., 31 July 2003, N. Wannathes 065 (CMU, SFSU); same location, 30 June 2004, N. Wannathes 192 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, New Waterfall, on 36 km. marker of Hwy1095, 2 July 2004, N. Wannathes 199 (CMU, SFSU); same location, 20 August 2004, N. Wannathes 261 (CMU, SFSU).

Discussion: *Marasmius tenuissimus* is characterized by a greyish orange to golden brown or light brown, plicate-reticulate pileus, remote, reticulate and intervenose lamellae, a short, eccentric to sublateral stipe, small basidiospores with mean 9.4 \times 5.3 μ m, and growth on woody debris. Interestingly, the ITS data indicate that *M. tenuissimus* is sister to *M. leveilleanus*, the only known species in sect. *Leveilleani*, and surprisingly distant from members of sect. *Sicci* where its morphology suggests it should be allied.

Section *Leveilleani*, Singer, Bull. Jard. Bot. Bruxelles 34: 362: 1964.

Type: *Marasmius leveilleanus* (Berk.) Pat.

27. *Marasmius leveilleanus* (Berk.) Pat., Bull. Soc. Mycol. Fr. 33: 35. 1917.

(Figs 32, 38-2)

= *Heliomyces leveilleanus* Berk., Lond. J. Bot. 6: 490. 1847.

= *Marasmius umbraculum* Berk. & Broome, J. Linn. Soc. Bot. 14: 36. 1873.

Pileus 14-43 mm diam., hemispherical to convex when young, convex to depressed in age, umbonate, striate to sulcate, glabrous, dull to shiny, disc dark brown (7F8) to brown (6E7-8), margin brown (7E8, 6D-E7) to brownish orange (6D6). *Context* cream, thin. *Lamellae* free, subdistant to close (17-25) with 0-1 series of lamellulae, broad (up to 5 mm), cream, non-marginate, non-intervenose. *Stipe* 22-90 × 0.5-1 mm, central, cylindrical, wiry, tough, hollow, glabrous, insititious, brown to dark brown overall; rhizomorphs sometimes present. *Odor* and *taste* not distinctive.

Basidiospores (8-)9-11(-12) × (3-)4(-5) μm [$x_{mr} = 9.0-10.7 \times 3.9-4.7$ μm, $x_{mm} = 9.6 \pm 0.7 \times 4.2 \pm 0.3$ μm, $Q_{mr} = 2.1-2.6$, $Q_{mm} = 2.3 \pm 0.2$, n = 25 spores, s = 6 specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 24-28 × 6-9 μm, cylindrical to clavate, 4-spored. *Basidioles* cylindrical to clavate. *Cheilocystidia* of *Siccus*-type broom cells; main body 12-28(-37) × 4-15 μm, cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae 1-5 × 1-2(-3) μm, conical to cylindrical, obtuse, hyaline, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 9-24(-36) × 5-11 μm, clavate to broadly clavate or pyriform, yellow to hyaline, inamyloid, thin- to thick-walled; apical setulae 3-6 × 1.5-3 μm, conical to cylindrical, obtuse, brown to light brown, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae (3-)5-12(-18) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-8(-10) μm diam., subparallel, cylindrical, brown to dark brown, smooth, weakly dextrinoid, thin- to thick-walled, non-gelatinous. *Stipe trama* hyphae (3-)5-8(-10) μm diam., subparallel, cylindrical, hyaline to pale yellow, smooth, weakly dextrinoid, thin-walled,

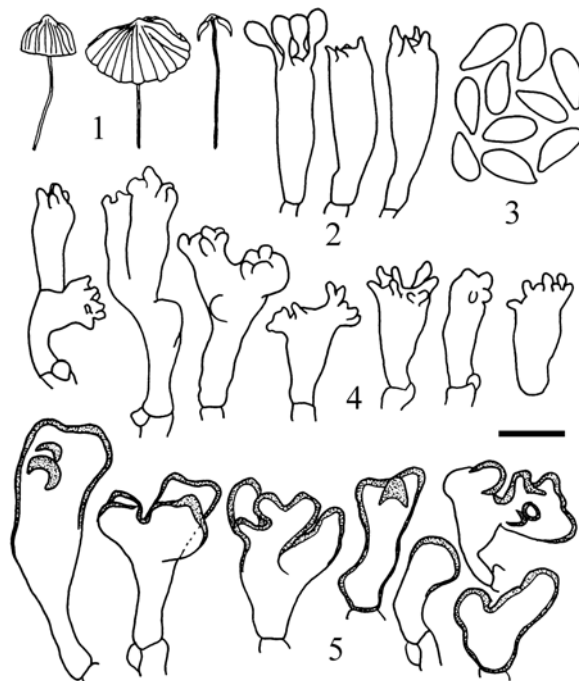


Fig. 32. *Marasmius leveilleanus* (N. Wannathes 268). 1. Basidiomes 2. Basidia 3. Basidiospores 4. Cheilocystidia 5. Pileipellis, Scale bar 1 = 20 mm, 2-5 = 10 μm

non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on wood, Africa, Mexico, Malaysia and Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 28 August 2003, N. Wannathes 137 (CMU, SFSU); same location, 29 June 2004, Y. S. Tan 276 (CMU, SFSU); Chiang Mai Province, Chiang Mai University, 5 August 2004, N. Wannathes 248 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, New Waterfall, on 36 km. marker of Hwy1095, 20 August 2004, N. Wannathes 264 (CMU, SFSU); same location, 30 June 2005, N. Wannathes 381 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 21 August 2004, N. Wannathes 268 (CMU, SFSU); Chiang Rai Province, Muang District, Khun Con Waterfall, 12 June 2005, N. Wannathes 308, (CMU, SFSU).

Discussion: *Marasmius leveilleanus* is distinguished by a relatively large sulcate pileus colored brown to brownish orange, free, non-collariate lamellae, a wiry, tough, dark brown, insititious stipe, *Siccus*-type broom cells, moderately sized basidiospores with mean 9.6×4.2 μm, non-dextrinoid tissues, and lignicolous habit. Macromorphological features suggest that the species is allied with members of sect. *Marasmius* (e.g., wiry, insititious stipe) although the lamellae are free and not collariate,

while micromorphological features suggest that it is allied with members of sect. *Sicci* (e.g., *Siccus*-type broom cells). Because of the unusual combination of features and especially the free lamellae and inamyloid tissues, Singer (1964) erected the monotypic sect. *Leveilleani* to accommodate the species. The ITS data presented here support its distinction from members of both sects. *Marasmius* and *Sicci*, and suggest that it is more closely allied with *M. tenuissimus* of sect. *Neosessiles*. It should be noted that *M. leveilleanus* is phenetically very similar to *M. nodulocystis* Pegler, described from Africa. A comparison of the descriptions of both species as reported by Pegler (1977) and Antonín (2007) indicate that they differ primarily in *M. nodulocystis* having dextrinoid tissues, and *M. leveilleanus* having an insititious stipe base and sometimes rhizomorphs. The stipe basal attachment of *M. nodulocystis* was not described although it has been interpreted as non-insititious because the species is accepted in sect. *Sicci*.

Section *Sicci* Singer, Mycologia 50: 106. 1958.

Type: *Marasmius siccus* (Schwein.) Fr.

Subsect. *Siccini*, ser. *Spinulosi* (Cléménçon) Desjardin, in Antonín & Noordeloos, Lib. Bot. 8: 179. 1993.

Type: *Marasmius cohaerens* (Pers.) Cooke & Quél. [Bas. *Agaricus cohaerens* Pers.].

= series *Actinopus* Singer, *pro parte*, Fl. Neotrop. Monogr. 17: 236. 1976.

28. *Marasmius coarctatus* Wannathes, Desjardin & Lumyong, sp. nov.

(Figs 33, 38-3)

MycoBank: MB512417

Etymology: ‘*coarctatus*’ (L) = close-set, crowded; referring to the lamellae spacing.

Pileus 10-27 mm diametro, convexus usque plano-convexus, saepe subumbonatus, laevis usque pellucido-striatus, velutinus, hebetatus, brunneus cum perpaulo coloris olivacei usque brunneo-ravus vel brunneo-aurantiacus. *Contextus* laete flavo-brunneus, tenuis. *Lamellae* anguste adnatae usque annexae, coarctatae (33-36) cum 3-5 seriebus lamellularum, angustae, obscure flavae, haud marginatae vel brunneomarginatae, haud intervenosae. *Stipes* 41-60 × 1-2 mm, centralis, cylindricus, cavus, hispidulus, haud insititius, apice pallide flavo, basi atrobrunnea. *Odor saporeque* non propria. *Basidiosporae* 6-8(-10) × 2.5-3.5

µm, ellipsoideae, laeves, hyalinae, inamyloideae, tenuitunicatae. *Basidia* non observata. *Basidiolae* clavatae. *Cheilocystidia* abundantia, 2 typorum: a) cellulis dispersis typi *Sicci* 12-23 × 5-7(-10)µm, cylindratis usque clavatis, hyalinis, inamyloideis, tenuitunicatis; setulis apicalibus 5-15 × 1-2 µm, cylindratis, obtusis usque subacutis, hyalinis usque pallide flavis, tenui- usque crassetunicatis; b) cheilosetis 25-57 × 4-6 µm, fusoideis usque lanceolatis, subacutis usque acutis, hyalinis, inamyloideis, tenui- usque crassetunicatis. *Pleurosetae* nullae vel rariae, 30-60 × 4-6 µm, fusoideae usque lanceolatae, subacutae usque acutae, hyalinae, inamyloideae, tenui- usque crassetunicatae. *Pileipellis* hymeniformis, leniter maculosus, 3 typorum: a) cellulis typi *Sicci* 11-20 × 6-10 µm, cylindratis usque clavatis, flavis, inamyloideis, tenui- usque crassetunicatis; setulis apicalibus 3-7(15) × 1-2 µm, coarctatis, cylindratis usque conicis, obtusis usque subacutis, brunneis, tenuitunicatis; b) pileosetis 34-60 × 5-8 µm, vulgaribus, dispersis, lanceolatis usque fusoideis, interdum lobatis, subacutis usque acutis, hyalinis usque pallide flavo-brunneis, inamyloideis, crassetunicatis; c) intermediis inter cellulas scopiformes et setas 24-39 × 7-11 µm; paucis setularum apicalium 7-37 × 2-4 µm, crassetunicatis. *Trama pilei* intertexta, dextrinoidea. *Trama lamellae* regularis usque intertexta, hyphis 4-14(-20) µm diametro, cylindratis, laevibus, hyalinis, dextrinoideis, tenuitunicatis, haud gelatinosis. *Stipitipellis* subparallelus, hyphis 6-10(-20) µm diametro, cylindratis, flavis usque laete brunneis, laevibus, dextrinoideis, tenui- usque crassetunicatis (usque ad 1 µm), haud gelatinosis. *Trama stipitis* parallela, hyphis (8-)14-18 µm diametro, cylindratis, hyalinis, laevibus, dextrinoideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* 2 typorum: a) cellulis typi *Sicci* 6-11 × 5-7 µm, cylindratis vel adumbratim inaequabilibus, flavis, inamyloideis, tenuitunicatis; 3-5 setulis apicalibus, 5-26 × 1-3 µm, cylindratis, subacutis usque acutis, flavis usque laete brunneis, tenuitunicatis; b) caulosetis 38-68 × 6-9 µm, lanceolatis usque fusoideis, raro furcatis, flavis, inamyloideis, crassetunicatis. *Fibulae* praesentes in omnibus texturis.

Typus: Chiang Mai Province, Doi Suthep-Pui National Park, trail opposite with the way to Huai Kok Ma Village, solitarius in folis plantae dicotyledoneae vel ligno, 2 July 2005 N. Wannathes 385 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 10-27 mm diam., convexus to plano-convex, often subumbonate, smooth or pellucid-striate, velutinous, dull, brown with a hint of olive to brownish beige (6F3) or brownish orange (5C5). *Context* light yellowish brown (5D4), thin. *Lamellae* narrowly adnate to adnexed, crowded (33-36) with 3-5 series of lamellulae, narrow, dull yellow (3B3) with or without brown edges, non-intervenose. *Stipe* 41-60 × 1-2 mm, central, cylindrical, hollow, hispidulous, non-insititious, apex pale yellow



Fig. 33. *Marasmius coarctatus* (N. Wannathes 385). 1. Basidiomes 2. Basidiole 3. Basidiospores 4a. *Siccus*-type cheilocystidia 4b. Cheiloseetae 5a. *Siccus*-type pileipellis 5b. Cells transitional between broom cells and setae 5c. Pileosetae 6a. *Siccus*-type caulocystidia 6b. Caulosetae, Scale bar 1 = 10 mm, 2-6 = 10 μ m

(4A3), base dark brown (9F6). *Odor* and *taste* not distinctive.

Basidiospores 6-8(-10) \times 2.5-3.5 μ m [x_{mr} = 6.4-6.8 \times 3.0 μ m, x_{mm} = 6.6 \pm 0.4 \times 3.0 \pm 0.2 μ m, Q_{mr} = 2.1, Q_{mm} = 2.1, n = 15-25 spores, s = 2 specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* clavate. *Cheilocystidia* abundant, composed of 2 types of cells: a) scattered *Siccus*-type broom cells with main body 12-23 \times 5-7(-10) μ m, cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae 5-15 \times 1-2 μ m, cylindrical, obtuse to subacute, hyaline to pale-yellow, thin- to thick-walled; b) cheiloseetae 25-57 \times 4-6 μ m, fusoid to lanceolate, subacute to acute, hyaline, inamyloid, thin- to thick-walled. *Pleurosetae* absent or seldom present, 30-60 \times 4-6 μ m, fusoid to lanceolate, subacute to acute, hyaline, inamyloid, thin- to thick-walled. *Pileipellis* hymeniform, weakly mottled, composed of 3 types of cells: a) *Siccus*-type broom cells with main body 11-20 \times 6-10 μ m, cylindrical to clavate, yellow, inamyloid, thin- to thick-walled; apical setulae 3-7(15) \times 1-2 μ m, crowded, cylindrical to conical, obtuse to subacute, brown, thick-walled; b) pileosetae, common, scattered, 34-60 \times 5-8 μ m, lanceolate

to fusoid, sometime lobed, subacute to acute, hyaline to pale yellowish brown, inamyloid, thick-walled; c) cells transitional between broom cells and setae, 24-39 \times 7-11 μ m, with few apical setulae 7-37 \times 2-4 μ m, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 4-14(-20) μ m diam., regular to interwoven, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 6-10(-20) μ m diam., subparallel, cylindrical, yellow to light brown, smooth, dextrinoid, thin- to thick-walled (up to 1 μ m), non-gelatinous. *Stipe trama* hyphae (8-)14-18 μ m diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* composed of 2 types of cells: a) *Siccus*-type broom cells with main body 6-11 \times 5-7 μ m, cylindrical or irregular in outline, yellow, inamyloid, thin-walled; apical setulae 5-26 \times 1-3 μ m, ranging from 3-5 setulae per cell, cylindrical, subacute to acute, yellow to light brown, thin-walled; b) caulosetae 38-68 \times 6-9 μ m, lanceolate to fusoid, seldom forked, yellow, inamyloid, thick-walled. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Solitary on dicotyledonous leaves or on wood, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park Medicinal plant garden, 16 June 2005, N. Wannathes 315 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, trail opposite with the way to Huai Kok Ma Village, 2 July 2005 N. Wannathes 385 (CMU: **holotype**; SFSU: **isotype**).

Discussion: *Marasmius coarctatus* is distinguished by the following features: a medium size pileus that is smooth or pellucid-striate and coloured brown with a hint of olive; crowded (33-36), narrow, dull yellow lamellae; a hispidulous stipe; small basidiospores with mean 6.6 \times 3.0 μ m; a lack of pleurocystidia and pleurosetae (rarely present); and presence of distinctive pileosetae, cheiloseetae and caulosetae. The new Thai species is similar to *M. cohaerens* var. *lachnophyllus* (Berk.) Gilliam described from North America, but the latter species differs in forming larger pilei (10-60 mm diam.) that are dark reddish brown, broader (1-2 mm) lamellae with reddish brown edges, slightly larger basidiospores (6.5-9 \times 3.2-4.8 μ m, x_m = 7.6 \times 4.1 μ m), and brownish orange to reddish brown, dextrinoid setae up to

20 μm diam. (Desjardin, 1989). *Marasmius coarctatus* is also similar to *M. coklatus* Desjardin, Retn. & E. Horak, described from Indonesia, but the latter differs in forming larger (15-60 mm diam.) chocolate brown pilei, remote to distant (10-15) lamellae 4-12 mm broad, and larger basidiospores in the range 10-11 \times 4.5-6 μm with mean 10.3 \times 5.3 μm . Other micromorphological features are similar except for occasional dextrinoid setae; they are all inamyloid in the Thai species (Desjardin *et al.*, 2000). Two additional phenetically similar species are *M. nexus* Desjardin & E. Horak and *M. acanthocheilus* Desjardin & E. Horak, both described from Papua New Guinea (Desjardin and Horak, 1997), *Marasmius nexus* differs in forming *Globulares*-type cell in the pileipellis, broader hymenial setae (up to 13 μm), and grows on wood. *Marasmius acanthocheilus* differs in forming a rusty orange pileus, larger basidiospores (9-10.5 \times 4-4.5 μm), and grows on grass or bamboo leaves.

29. *Marasmius trichotus* Corner, Beih. Nova Hedwigia 111: 102. 1996. (Figs 34, 38-4)

Pileus 6-23 mm diam., broadly conical to convex when young, plano-convex with or without an umbo in age, smooth (non-striate), hispidulous with erect golden hairs, dull, pale orange (5A5) to orange (6A-B7-8), golden yellow (5B7-8) or pale brownish orange (5C4-5), sometimes orangish white (4-5A3) at the margin. *Context* yellowish white, thin. *Lamellae* adnexed to narrowly adnate, subdistant to close (12-22) with 2-4 series of lamellulae, narrow, yellowish white, non-marginate, non-intervenose. *Stipe* 15-90 \times 0.5-1 mm, central, cylindrical, hollow, hispid with brown hairs overall, non-insititious, apex yellowish white (4-5A2) to pale orange (5A3-5), base brownish orange (6C5-6), rarely to brown (7E7-8) or reddish brown (8E-F8). *Odor* and *taste* not distinctive.

Basidiospores (10-)12-15(-16) \times 3-5 μm [x_{mr} = 10.6-14 \times 3.7-4.6 μm , x_{mm} = 12.1 \pm 0.8 \times 4.1 \pm 0.16 μm , Q_{mr} = 2.9-3.4, Q_{mm} = 3.1 \pm 0.2, n = 25 spores, s = 13 specimens], fusoid to narrowly ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 14-16 \times 8-9 μm , clavate, 4-spored. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, composed of *Siccus*-

type broom cells; main body (9-)15-28 \times 6-15 μm , cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae 2-5(-8) \times 1(-2) μm , conical to cylindrical, obtuse to subacute, yellow, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, mottled, composed of 2 types of cells: a) *Siccus*-type broom cells with main body 14-26(-41) \times 6-10 μm , cylindrical to clavate, seldom branched, hyaline to yellow, inamyloid, thin- to thick-walled; apical setulae (2-)4-8(-14) \times 1-1.5 μm , crowded, cylindrical, obtuse to subacute, brownish yellow, thick-walled; b) pileosetae, common, scattered, 60-300 \times 5-15 μm , lanceolate to fusoid, subacute to acute, golden to golden brown, inamyloid, thick-walled (up to 2 μm). *Pileus trama* hyphae 3-6(-9) μm , interwoven, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled. *Lamellar trama* hyphae 3-8(-10) μm diam., regular to intervoven, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-5 μm diam, subparallel, cylindrical, yellowish brown to brown, smooth, inamyloid to weakly dextrinoid, thick-walled (up to 1.5 μm), non-gelatinous. *Stipe trama* hyphae 4-7(-11) μm diam., subparallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulosetae* abundant, 22-213 \times 4-7(-15) μm , fusoid to lanceolate, sometimes cylindrical, brown, inamyloid, thick-walled. *Clamp connections* present in all tissues.

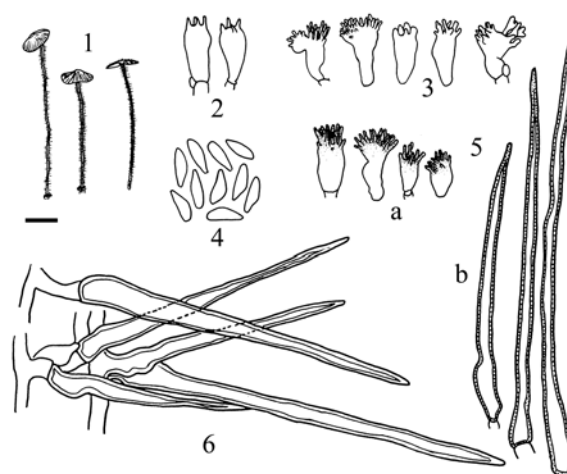


Fig. 34. *Marasmius trichotus* (N. Wannathes 262). 1. Basidiomes 2. Basidia 3. Cheilocystidia 4. Basidiospores 5a. *Siccus*-type pileipellis 5b. Pileosetae 6. Caulosetae. Scale bar 1 = 10 mm, 2-6 = 10 μm

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, Northern Thailand, Papua New Guinea and Singapore.

Material examined: Thailand. Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., 26 June 2003, N. Wannathes 006 (CMU, SFSU); same location, 25 June 2004, N. Wannathes 178 (CMU, SFSU); same location, 3 July 2004, Y.S. Tan 295 and 296 (CMU, SFSU); same location, 27 June 2005, N. Wannathes 355 (CMU, SFSU); Chiang Mai Province, Mushroom Research Centre, 27 km marker on Hwy 1095, 13 July 2003, N. Wannathes 024 (CMU, SFSU); same location, 27 July 2003, N. Wannathes 037 and N. Wannathes 039 (CMU, SFSU); same location, 28 July 2003, N. Wannathes 045 (CMU, SFSU); same location, 10 August 2003, N. Wannathes 098 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 1 August 2003, N. Wannathes 074 (CMU, SFSU), same location, 25 June 2005, N. Wannathes 326 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, New Waterfall, on 36 km. marker of Hwy1095, 20 August 2004, N. Wannathes 262 and N. Wannathes263 (CMU, SFSU); Phrae Province, Muang District, Suen Keun, Na Koo Haa Waterfall, 15 August 2005, N. Wannathes 408 (CMU, SFSU); Phrae Province, Muang District, Pa Dang, Nong Kam Village, near Nong Kam reservoir, 18 August 2005, N. Wannathes 429 (CMU, SFSU).

Discussion: *Marasmius trichotus* is easily recognized in the field by the orange to brownish orange pileus stipe, both covered with erect golden brown hairs. In addition, the species has close (16-22) lamellae, narrowly ellipsoid basidiospores with mean $12.1 \times 4.1 \mu\text{m}$, and lacks hymenial setae. Thai populations differ from Papua New Guinea and Singapore populations only in forming larger pilei (6-23 mm diam. vs 4-12 mm diam.) that are slightly paler. All pertinent diagnostic features are indistinguishable.

30. *Marasmius nummularius* Berk. & Broome, J. Linn. Soc. Bot. 14: 33. 1873.

(Figs 35, 38-5)

Pileus 6-20 mm diam., broadly conical to convex when young, plano-convex to depressed and often umbonate in age, pruinose to subvelutinous, dull; disc wrinkled, reddish brown (8E7); margin striate, brown (6-7E6-8). *Context* pale orange (6A3), thin. *Lamellae* adnexed to subadnate, subdistant (12-18) with 2-3 series of lamellulae, narrow, pale orange (6A3) with pinkish brown edge, non-

intervenose. *Stipe* 20-45 \times < 1 mm, central, cylindrical, hollow, velutinous to hispid, non-insititious, apex brownish orange (6C6-8), base reddish brown (8E7). *Odor* and *taste* not distinctive.

Basidiospores 12-14 \times 3-4.5 μm [$x_{\text{mr}} = 12.9-13.6 \times 3.8-4.0 \mu\text{m}$, $x_{\text{mm}} = 13.2 \pm 0.5 \times 3.9 \pm 0.1 \mu\text{m}$, $Q_{\text{mr}} = 3.3-3.6$, $Q_{\text{mm}} = 3.4 \pm 0.2$, $n = 25$ spores, $s = 2$ specimens], fusoid to narrowly ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, composed of *Siccus*-type broom cells; main body 14-21 \times 5-13 μm , cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin-walled; apical setulae 2-7 \times 1 μm , cylindrical, obtuse to subacute, dark brown to black, thick-walled. *Pleurocystidia* absent or rare, of *Siccus*-type broom cells like the cheilocystidia; *pleurosetae* absent. *Pileipellis* hymeniform, mottled, composed of 2 types of cells: a) *Siccus*-type broom cells with main body (5-)14-28 \times 7-18 μm , cylindrical to clavate or turbinate, hyaline to yellow, inamyloid, thin- to thick-walled; apical setulae (2-)3-9(-13) \times 1-1.5 μm , crowded, cylindrical, obtuse to subacute, brown to reddish brown, thick-walled; b) pileosetae, absent or rare, scattered, 100-115 \times 8-13 μm lanceolate to fusoid, subacute to acute, hyaline to reddish brown, inamyloid, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* regular; hyphae 4-9 μm diam., cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-6 μm diam., subparallel, cylindrical, yellow to light brown, smooth, inamyloid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 4-7 μm diam., subparallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* composed of 2 types of cells: a) *Siccus*-type broom cells with main body 8-18(-36) \times 5-10(-15) μm , cylindrical to clavate or irregular in outline, hyaline to yellow, inamyloid, thin-walled; apical setulae 2-9(-23) \times 1-2 μm , cylindrical, subacute to acute, yellow, thick-walled; b) caulosetae 45-110 \times 9-16 μm , fusoid to lanceolate, often apically or centrally setulose (2-4 setules per cell), hyaline to yellow, inamyloid, thick-walled. *Clamp connections* present in all tissues.

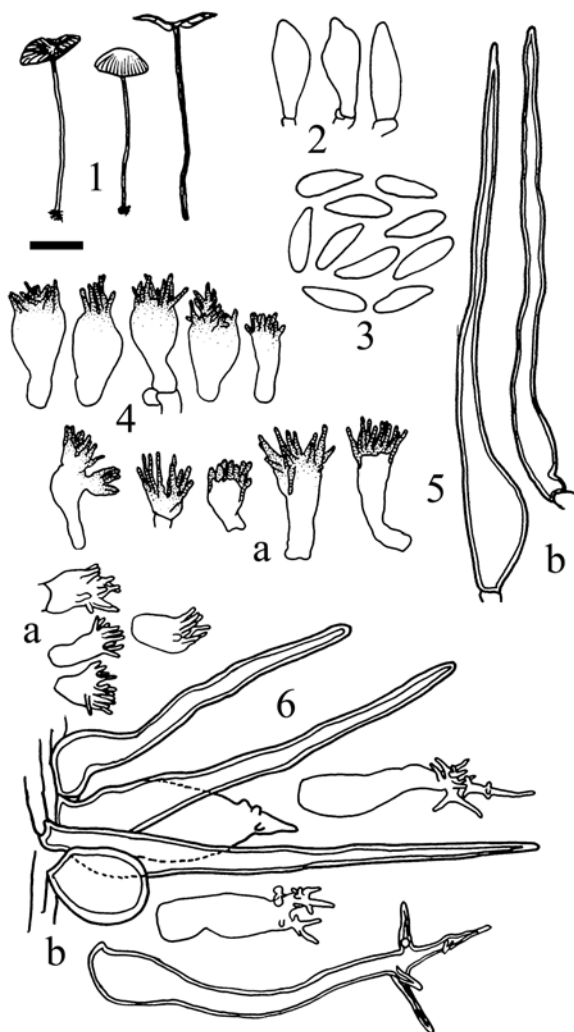


Fig. 35. *Marasmius nummularius* (N. Wannathes 266). 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5a. *Siccus*-type pileipellis 5b. Pileosetae 6a. *Siccus*-type caulocystidia 6b. Caulosetae, Scale bar 1 = 10 mm, 2-6 = 10 μ m

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, Sri Lanka, Java and Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 21 August 2004, N. Wannathes 226, (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Medicinal Plant Garden, 3 August 2005, N. Wannathes 396 (CMU, SFSU).

Discussion: *Marasmius nummularius* is characterized by a reddish brown rugulose-striate pileus, subdistant (12-18) lamellae with pinkish brown edges, narrowly ellipsoid basidiospores with mean $13.2 \times 3.9 \mu$ m, scattered pileosetae, no pleurosetae, and a velutinous to hispid stipe covered with caulosetae that are often apically setulose. The

Thai material matches nicely with Indonesian material as described by Desjardin *et al.* (2000).

31. *Marasmius coklatus* Desjardin, Retnowati & E. Horak, *Sydowia* 52: 146. 2000. (Fig. 36)

Pileus 17-33 mm diam., broadly conical to campanulate, subumbonate, smooth to weakly striate, subvelutinous, dull, disc dark brown (7F8), margin brown (6E6-7) to yellowish brown (5E7). **Context** greyish brown, thin. **Lamellae** adnate, subdistant (12-15) with 1 series of lamellulae, broad, orangish white (5A2) with yellowish brown edges, non-intervenose. **Stipe** 18-35 \times 1.5-2 mm, central, cylindrical, hollow, pruinose, non-insititious, apex pale yellow (4A3), base brown (6E8). **Odor and taste** not distinctive.

Basidiospores (10-)11-12(-13) \times (5.5-)6-7 μ m [$x_m = 11.2 \pm 0.6 \times 6.1 \pm 0.3 \mu$ m, $Q = 1.6-2.0$, $Q_m = 1.8$, $n = 25$ spores, $s = 1$ specimen], ellipsoid, smooth, hyaline, inamyloid, thin-walled. **Basidia** not observed. **Basidioles** fusoid to clavate. **Cheilocystidia** abundant, composed of 2 types of cells: a) *Siccus*-type broom cells, scattered with main body (9-)16-20 \times 6-9 μ m, cylindrical to clavate or turbinate, hyaline, inamyloid, thick-walled; apical setulae 4-12 \times 1-3 μ m, cylindrical to conical, obtuse to subacute, brown, thick-walled; b) cheilosetae 20-44 \times 4-6 μ m, fusoid to lanceolate, often forked, subacute to acute, brown, inamyloid, thick-walled. **Pleurosetae** abundant, 20-44 \times 4-6 μ m, fusoid to lanceolate, often forked, subacute to acute, brown, inamyloid, thick-walled. **Pileipellis** hymeniform, mottled, composed of 2 types of cells: a) *Siccus*-type broom cells with main body (9-)16-37 \times 6-11 μ m, cylindrical to clavate, hyaline to yellow, inamyloid, thick-walled; apical setulae 4-20 \times 1.5-3 μ m, crowded, cylindrical to conical, subacute, brown to dark brown, thick-walled; b) pileosetae, common, scattered, 35-38 \times 7-9 μ m lanceolate to fusoid, conical to subacute, yellow to yellowish brown, inamyloid, thick-walled. **Pileus trama** interwoven, inamyloid. **Lamellar trama** hyphae 6-12 μ m diam., interwoven, cylindrical to inflated, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. **Stipitipellis** hyphae 6-9(-12) μ m diam., parallel, cylindrical, brown to light brown, smooth, inamyloid, thick-walled (up to 2 μ m),



Fig. 36. *Marasmius coklatus* (S.Y. Tan.301) 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Hymenial setae 5a. Siccus-type pileipellis 5b. Pileosetae 6a. Siccus-type caulocystidia 6b. Caulosetae, Scale bar 1 = 10 mm, 2-6 = 10 μ m

non-gelatinous. *Stipe trama* hyphae 7- 17 μ m diam., parallel, cylindrical, hyaline, smooth, weakly dextrinoid to inamyloid, thin-walled, non-gelatinous. *Caulocystidia* composed of 2 types of cells: a) *Siccus*-type broom cells with main body 18-26 \times 7 μ m, cylindrical or irregular in outline, often lobed, yellow, inamyloid, thick-walled; apical setulae 15-26 \times 2-3 μ m, ranging from 2-4 setulae per cell, cylindrical, subacute to acute, yellow to light brown, thick-walled; b) caulosetae 39-52 \times 6-7 μ m, fusoid to lanceolate, seldom lobed, yellow, inamyloid, thick-walled. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, Java and Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., 3 July 2004, T.Y. Shin 301 (CMU, SFSU).

Discussion: *Marasmius coklatus*, described originally from material collected in Indonesia by Desjardin *et al.* (2000), is characterized by a dark chocolate brown, velutinous pileus, distant to subdistant, broad, lamellae with yellowish brown edges, a brown,

pruinose stipe covered with caulosetae, moderately long and broad basidiospores, and numerous pileo-, cheilo-, pleuro- and caulosetae that are often forked.

32. *Marasmius araneocephalus* Wannathes, Desjardin & Lumyong, sp. nov.

(Figs 37, 38-6)

MycoBank: MB512418

Etymology: 'aranea' = spider; 'cephalus' = head; referring to the spider-like broom cells on the pileus surface.

Pileus 20-42 mm diametro, convexus, depressione exigua ad discum regulosum, pellucido-striatus usque reticulato-venosus, glaber, hebetatus, disco purpureo-atrobrunneo, margine cinereo-brunneo. **Contextus** rubro-cinereus, tenuis. **Lamellae** adnatae, subdistantes (10-12) cum 3 seriebus lamellarum, latae (3-5 mm), brunneo-aurantiacaе, atropurpureomarginatae, eminenter intervenosae usque reticulatae. **Stipes** 27-45 \times 1-2 mm, centralis, cylindratus, cavus, hispidus cum pilis purpureo-atrobrunneis, haud insititius, apice brunneo-cinereo, basi laete brunnea. **Odor saporque** non propria. **Basidiosporae** 6-7 (-8) \times 3.5-4 μ m, ellipsoideae, laeves, hyalinae, inamyloideae, tenuitunicatae. **Basidia** non observata. **Basidiolae** fusoideae usque clavatae. **Cheilocystidia** abundantia, 2 typorum: a) cellulis typi *Sicci* 13-22 \times 5-7 μ m, cylindratis vel adumbratim inaequabilibus, hyalinis, inamyloideis, tenui- usque crassetunicatis (usque ad 0.5 μ m); 2-4 setulis apicalibus, 3-16 \times 1-3 μ m, cylindratis usque conicis, obtusis usque subacutis, flavis, tenui- usque crassetunicatis (usque ad 0.5 μ m); b) cheilosetis 19-22 \times 4-6 μ m, cylindratis vel adumbratim inaequabilibus, obtusis usque subacutis, hyalinis, inamyloideis, tenui- usque crassetunicatis (usque ad 0.5 μ m). **Pleurosetae** vulgares, cheilosetis similes, 25-38 \times 4-6 μ m, fusoideae usque ventricosofusoideae, raro clavatae, obtusae usque subacutae, interdum furcatae, pallide flavae, inamyloideae, tenui- usque crassetunicatae. **Pileipellis** hymeniformis, haud maculosus, 2 typorum: a) cellulis typi *Sicci* 13-18 \times 6-10 μ m, cylindratis usque clavatis vel late clavatis, hyalinis, inamyloideis, tenuitunicatis; setulis apicalibus 2-5 (-23) \times 1-2 (-4) μ m, coarctatis, cylindratis usque conicis, obtusis usque subacutis, purpureo-brunneis, tenuitunicatis; b) cellulis araneae similibus, dispersis, 16-38 \times 7-8 μ m, cylindratis vel adumbratim inaequabilibus, flavis usque laete brunneis, inamyloideis, crassetunicatis; 3-6 setulis apicalibus, (4-) 30-70 \times 2-3 μ m, cylindratis, subacutis usque acutis, flavis usque laete brunneis, inamyloideis, crassetunicatis. **Trama pilei** intertexta, dextrinoidea. **Trama lamellae** intertexta, hyphis 2-7 μ m diametro, cylindratis, laevibus, hyalinis, dextrinoideis, tenuitunicatis, haud gelatinosis. **Stiptipellis** subparallelus, hyphis 4-8 μ m diametro, cylindratis, flavis usque laete brunneis, laevibus, dextrinoideis, tenui- usque crassetunicatis (usque ad 1 μ m), haud gelatinosis. **Trama stiptis** parallela, hyphis 8-13 μ m diametro, cylindratis, hyalinis, laevibus, dextrinoideis, tenuitunicatis, haud gelatinosis. **Caulocystidia** 2 typorum: a) cellulis typi

Sicci 12-31 × 5-6 μm, cylindratis, hyalinis, inamyloideis, tenui- usque crassetunicatis; 2-3 setulis apicalibus, 10-20 × 1.5-2 μm, cylindratis, obtusis usque subacutis, hyalinis usque flavis, crassetunicatis; b) cauloseis 40-50 × 4-6 μm, polymorphis, cylindratis usque clavatis vel adumbratim inaequalibus, saepe furcatis, hyalinis, inamyloideis, crassetunicatis. *Fibulae* praesentes in omnibus texturis.

Typus: Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., dispersus usque gregarius in folis plantae dicotyledoneae vel ligno, 27 June 2005, N. Wannathes 358 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 20-42 mm diam., convex with a slightly depressed, rugulose disc, pellucid-striate to venose-reticulate, glabrous, dull, disc dark purplish brown (14F4), margin greyish brown (7E3). *Context* reddish grey (12C2), thin. *Lamellae* adnate, subdistant (10-12) with 3 series of lamellulae, broad (3-5 mm), brownish orange (6C3) with dark purple edges, strong intervenose to reticulate. *Stipe* 27-45 × 1-2 mm, central, cylindrical, hollow, hispid with dark purple (14F4) hairs, non-insititious, apex brownish grey (11C2), base light brown. *Odor* and *taste* not distinctive.

Basidiospores 6-7 (-8) × 3.5-4 μm [$x_m = 6.6 \pm 0.6 \times 3.9 \pm 0.3 \mu\text{m}$, $Q = 1.2 - 2.0$, $Q_m = 1.7$, $n = 25$ spores, $s = 1$ specimen], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, composed of 2 types of cells: a) *Siccus*-type broom cells with main body 13-22 × 5-7 μm, cylindrical or irregular in outline, hyaline, inamyloid, thin- to thick-walled (up to 0.5 μm); apical setulae 3-16 × 1-3 μm, cylindrical to conical, ranging from 2-4 setulae per cell, obtuse to subacute, yellow, thin- to thick-walled (up to 0.5 μm); b) cheiloseis 19-22 × 4-6 μm, cylindrical or irregular in outline, obtuse to subacute, hyaline, inamyloid, thin- to thick-walled (up to 0.5 μm). *Pleurosetae* common, like the cheiloseis, 25-38 × 4-6 μm, fusoid to fusoid-ventricose, rarely clavate, obtuse to subacute, sometimes forked, pale yellow, inamyloid, thin- to thick-walled. *Pileipellis* hymeniform, not mottled, composed of 2 types of cells: a) *Siccus*-type broom cells with main body 13-18 × 6-10 μm, cylindrical to clavate or broadly broom cells, scattered, with main body 16-38 × 7-8 μm, cylindrical or irregular in outline, yellow to light brown,

inamyloid, thick-walled; apical setulae(4-) 30-70 × 2-3 μm, ranging from 3-6 setulae per cell, cylindrical, subacute to acute, yellow to light brown, inamyloid, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 2-7 μm diam., interwoven, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 4-8 μm, subparallel, cylindrical, yellow to light brown, smooth, dextrinoid, thin- to thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 8-13 μm, parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* composed of 2 types of cells: a) *Siccus*-type broom cells with main body 12-31 × 5-6 μm, cylindrical, hyaline, inamyloid, thin- to thick-walled; apical setulae 10-20 × 1.5-2 μm, ranging from 2-3 setulae per cell, cylindrical, obtuse to subacute, hyaline to yellow, thick-walled; b) cauloseis 40-50 × 4-6 μm, polymorphic, cylindrical to clavate or irregular in outline, often forked, hyaline, inamyloid, thick-walled. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves or on wood, Northern Thailand.

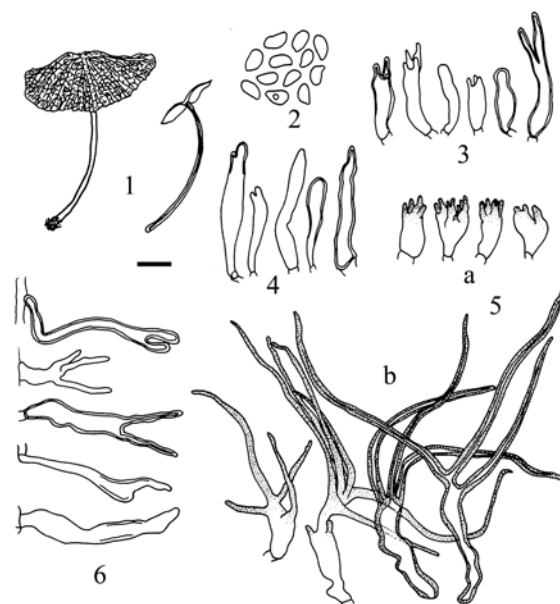


Fig. 37 *Marasmius araneocephalus* (N. Wannathes358) 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pleurocystidia 5a. *Siccus*-type pileipellis 5b. Spider-like pileipellis 6. Caulocystidia, Scale bar 1 = 10 mm, 2-6 = 10 μm



Fig. 38. Basidiomata of *Marasmius* section *Neosessiles*, *Leveilleani* and Section *Sicci* ser. *Spinulosi*. 1. *M. tenuissimus* (N. Wannathes 199) 2. *M. leveilleanus* (N. Wannathes 248) 3. *M. coarctatus* (N. Wannathes 385) 4. *M. trichotus* (N. Wannathes 326) 5. *M. nummularius* (N. Wannathes 266) 6. *M. araneocephalus* (N. Wannathes 358), Scale bars = 20 mm.

Material examined: Thailand. Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., 27 June 2005, N. Wannathes 358 (CMU: **holotype**; SFSU: **isotype**).

Discussion: *Marasmius araneocephalus* has the following diagnostic features: a venose-reticulate, greyish brown pileus with dark purplish brown disc; subdistant (10-12), strongly intervenose to reticulate lamellae; a light brown stipe covered with dark purple hairs; small basidiospores with mean $6.6 \times 3.9 \mu\text{m}$; and scattered spider-like broom cells on the pileus surface with setulae 30-70 μm long. Many micromorphological features of *M. araneocephalus* are similar to those of *M.*

coklatus, but the latter species differs in forming larger basidiospores ($x_m = 11.2 \times 6.1 \mu\text{m}$), a smooth, dark brown pileus, non-intervenose-reticulate lamellae, and lacks the distinctive spider-like pileipellis cells. In the field *M. araneocephalus* look like a dark form of *M. albimyceliosus*, but the latter is a member of sect. *Globulares* with distinctly different micromorphological features.

Section *Sicci*, subject. *Siccini*, ser. *Atrorubentes* Desjardin & Horak, *Biblio. Mycol.* 168: 27. 1997.

Type: *Agaricus atrorubens* Berk., *London J. Bot.* 1: 138. 1842.

[= *Marasmius atrorubens* (Berk.) Berk., Hooker's J. Bot. Kew. Gard. Misc. 8: 137. 1856].

33. *Marasmius auratus* Wannathes, Desjardin & Lumyong, **sp. nov.**

(Figs 39, 49-1)

MycoBank: 512419

Etymology: 'auratus' = gold; referring to the gold color of the pileus.

Pileus 5-30 mm diametro, late conicus, saepe margine erecto, laevis usque striatulus, pruinosis, hebetatus, disco aurato, margine aurantiaco usque flavo-aurantiaco vel cinereo-flavo. *Contextus* laete aurantiacus, tenuis. *Lamellae* adnatae, arctae (17-24) cum 3-4 seriebus lamellarum, angustae, creameae, haud marginatae, haud intervenosae. *Stipes* 35-68 × 1.5-2 mm, centralis, cylindratus, cavus, hispidulus usque hispidus, haud insititius, apice flavo-albo, basi rubro-atrobrunnea. *Odor* saporque non propria. *Basidiosporae* 11-14 × 4-5 μm, ellipsoideae, oblique curvae, laeves, hyalinae, inamyloideae, tenuitunicatae *Basidia* non observata. *Basidiolae* clavatae. *Cheilocystidia* nulla vel simplicia, 22-28 × 4-6 μm, cylindrata usque clavata vel adumbratim inaequabilia, raro lobata, hyalina, inamyloidea, tenuitunicata. *Pleurocystidia* nulla. *Pileipellis* hymeniformis, maculosus, typi *Sicci*; 9-26 × 5-11 μm, clavatus usque late clavatus, turbinatus vel adumbratim inaequabilis, hyalinus, inamyloideus, tenuis usque crassetunicatus; setulis apicalibus 3-9 × 1-2 μm, coartatis, cylindratis usque adumbratim inaequabilibus, obtusis usque subacutis, flavis, crassetunicatis. *Trama pilei* intertexta, dextrinoidea. *Trama lamellae* intertexta, hyphis (2-)4-8(-12) μm diametro, cylindratis usque inflatis, laevibus, hyalinis, dextrinoideis, tenuitunicatis, haud gelatinosis. *Stipitipellis* parallelus, hyphis 5-10(-15) μm diametro, cylindratis, flavis usque brunneis, laevibus, leniter dextrinoideis usque dextrinoideis, tenuis usque crassetunicatis (usque ad 0.5 μm), haud gelatinosis. *Trama stipitis* parallela, hyphis (4-)6-9(-11) μm diametro, cylindratis, hyalinis, laevibus, dextrinoideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* numerosa, 22-12 × 5-7 μm, cylindrata usque adumbratim inaequabilia, hyalina, inamyloidea usque leniter dextrinoidea, crassetunicata (usque ad 1 μm). *Fibulae* praesentes in omnibus texturis.

Typus: Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., dispersus usque gregarius in folis plantae dicotyledoneae, raro in ligno, 25 June 2004, N. Wannathes 175 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 5-30 mm diam., broadly conical, often with upturned margin, smooth to striatulate, pruinose, dull, disc golden yellow (5B7), margin orange (5A6-7) to yellowish orange (4B6-7) or greyish yellow (4B5). *Context* light orange (5A4), thin. *Lamellae* adnate, close (17-24) with 3-4 series of

lamellulae, narrow, cream, non-marginate, non-intervenose. *Stipe* 35-68 × 1.5-2 mm, central, cylindrical, hollow, hispidulose to hispid, non-insititious, apex yellowish white, base dark reddish brown. *Odor* and *taste* not distinctive.

Basidiosporae 11-14 × 4-5 μm [$x_{mr} = 11.9-12.6 \times 4.0-4.3$, $x_{mm} = 12.2 \pm 0.4 \times 4.1 \pm 0.1$ μm, $Q_{mr} = 2.8 - 3.1$, $Q_{mm} = 3.0 \pm 0.2$, $n = 25$ spores, $s = 3$ specimens], ellipsoid, curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* clavate.

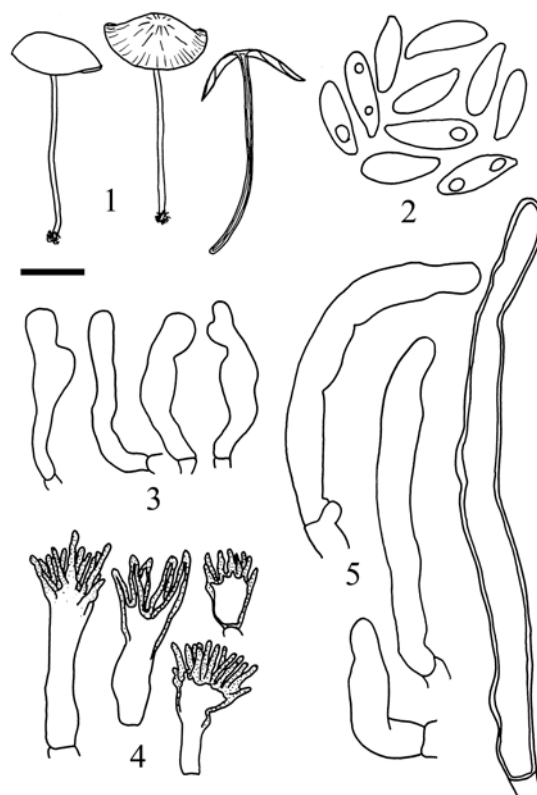


Fig. 39. *Marasmius auratus* (N. Wannathes351) 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pileipellis 5. Caulocystidia, Scale bar 1 = 20 mm, 2-5 = 10 μm

Cheilocystidia absent or simple, 22-28 × 4-6 μm, cylindrical to clavate or irregular in outline, seldom lobed, hyaline, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 9-26 × 5-11 μm, clavate to broadly clavate, turbinate or irregular in outline, hyaline, inamyloid, thin- to thick-walled; apical setulae 3-9 × 1-2 μm, crowded, cylindrical to irregular in outline, obtuse to subacute, yellow, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae (2-)4-8(-12) μm diam., interwoven, cylindrical to inflated,

smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 5-10(-15) μm diam., parallel, cylindrical, yellow to brown, smooth, weakly dextrinoid to dextrinoid, thin- to thick-walled (up to 0.5 μm), non-gelatinous. *Stipe trama* hyphae (4-)6-9(-11) μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* numerous, simple, 22-12 \times 5-7 μm , cylindrical to irregular in outline, obtuse, hyaline, inamyloid to weakly dextrinoid, thick-walled (up to 1 μm). *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Solitary, scattered to gregarious on dicotyledonous leaves, or rarely on wood. Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., 2 August 2003, N. Wannathes 076 (CMU, SFSU); same location, 25 June 2004, N. Wannathes 175 (CMU: **holotype**; SFSU: **isotype**); same location, 27 June 2005, N. Wannathes 351 (CMU, SFSU).

Discussion: *Marasmius auratus* is characterized by the following features: a golden yellow, smooth to striatulate pileus; close lamellae; dark reddish brown stipe; slender, moderately long basidiospores with mean 12.2 \times 4.1 μm ; cheilocystidia that are absent or only simple and basidiole-like; abundant, simple, cylindrical, obtuse, thick-walled, inamyloid caulocystidia; and growth on dicotyledonous leaves. This new Thai species is most phenetically similar to several Malaysian species (Tan *et al.*, 2009) that have simple caulocystidia. *Marasmius musicolor* Y.S. Tan & Desjardin differs in forming fewer lamellae (12-14), larger basidiospores with mean 16.1 \times 3.9 μm , has distinct *Siccus*-type cheilocystidia, and dextrinoid caulocystidia formed in clusters. *Marasmius ochropoides* Y.S. Tan & Desjardin differs in forming a smaller pileus (5-6 mm diam.), paler stipe (orangish white), smaller basidiospores with mean 10.6 μm , well-developed *Siccus*-type cheilocystidia, and dextrinoid caulocystidia. *Marasmius iras* Y.S. Tan & Desjardin differs in forming a brown pileus, slightly longer basidiospores with mean 14.1 \times 3.7 μm , well-developed *Siccus*-type cheilocystidia, and smaller, lobed or forked caulocystidia.

Marasmius auratus is also similar to two American species that are members of this series. *Marasmius actinopus* Mont. *sensu* Singer from South America differs in forming a sulcate pileus colored ochraceous yellow to dull olive brown, slightly narrower basidiospores (3-4 μm diam.), and has *Siccus*-type cheilocystidia (Singer, 1976; see also Desjardin and Horak, 1997: 27). *Marasmius ciliatomarginatus* Desjardin, described from North America, differs in forming a reddish brown pileus, larger basidiospores with mean 15.7 \times 4.0 μm , and red-marginate lamellae with cheilocystidia having reddish orange contents (Desjardin and Petersen, 1989).

34. *Marasmius pseudopellucidus* Wannathes, Desjardin & Lumyong, **sp. nov.**

(Figs 40, 49-3)

Mycobank: MB512420

Etymology: 'pseudo' = false; referring to the basidiomes which look like *M. pellucidus*.

Pileus 10-40 mm diametro, late conicus usque convexus cum disco leviter depresso et margine reflexo ubi vetus, pellucido-striatus, pruinosis, hebetatus, primo disco pallide flavo et margine albo demum ubique albus. *Contextus* albidus, tenuis. *Lamellae* adnatae, arctae (19-22) cum 2-3 seriebus lamellarum, angustae, albae, haud marginatae, intervenosae ubi vetus. *Stipes* 16-50 \times 1-2 mm, centralis, cylindratus, cavus, subvelutinus usque velutinus, haud insititius, apice albo, basi laete aurantiaca. *Odor* suavis. *Sapor* non proprius. *Basidiosporae* 10-12 \times 3.5-4.5 μm , ellipsoideae, oblique curvae, laeves, hyalinae, inamyloideae, tenuitunicatae. *Basidia* 33-35 \times 7-8 μm , clavata, 4-spora. *Basidiolae* clavatae. Margo lamellae sterilis; *cheilocystidia* simplicia, basidiolae similibus, 13-18 \times 3.5-10 μm , cylindrata usque clavata, raro adumbratim inaequabilia, hyalina, inamyloidea, tenuitunicata. *Pleurocystidia* nulla. *Pileipellis* hymeniformis, maculosus, typi *Sicci*; (9-)13-23 \times 7-13 μm , clavatus usque late clavatus vel turbinatus, saepe ramosus, hyalinus, inamyloideus, tenui- usque crassetunicatus; setulis apicalibus 2-12 \times 1-1.5 μm , coartatis, cylindratis, obtusis usque subacutis, flavis, crassetunicatis. *Trama pilei* intertexta, dextrinoidea. *Trama lamellae* intertexta, hyphis 4-9(-14) μm diametro, cylindratis usque inflatis, laevis, hyalinis, dextrinoideis, tenuitunicatis, haud gelatinosis. *Stipitipellis* parallelus, hyphis (4-)6-10 μm diametro, cylindratis, flavis usque brunneo-flavis, laevis, dextrinoideis, crassetunicatis (usque ad 1 μm), haud gelatinosis. *Trama stipitis* parallela, hyphis 6-14 μm diametro, cylindratis, hyalinis, laevis, dextrinoideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* numerosa, 23-87 \times 6-9 μm , cylindrata usque adumbratim inaequabilia, raro lobata, hyalina usque pallide flava, leniter dextrinoidea, tenui- usque crassetunicata (usque ad 2 μm). *Fibulae* praesentes in omnibus texturis.

Typus: Chiang Rai Province, Muang District, Khun Con Waterfall, dispersus usque gregarius, saepe caespitosus in putredine e bambusa, raro in folis plantae dicotyledoneae vel putridine ligneus, 12 June 2005, N. Wannathes 305 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 10-40 mm diam., broadly conical to convex with a slightly depressed disc and reflexed margin in age, pellucid-striate, pruinose, dull, disc pale yellow, margin white, fading to white overall. *Context* off-white, thin. *Lamellae* adnate, close (19-22) with 2-3 series of lamellulae, narrow, intervenose in age, white, non-marginate. *Stipe* 16-50 × 1-2 mm, central, cylindrical, hollow, subvelutinous to velutinous, non-insititious, apex white, base light orange (5B5). *Odor* sweet. *Taste* not distinctive.

Basidiospores 10-12 × 3.5-4.5 μm [$x_{mr} = 11.0-11.1 \times 4.0-4.2 \mu\text{m}$, $x_{mm} = 11.0 \pm 0.0 \times 4.1 \pm 0.1 \mu\text{m}$, $Q_{mr} = 2.6-2.8$, $Q_{mm} = 2.7 \pm 0.1$, $n = 25$ spores, $s = 2$ specimens], ellipsoid, curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* 33-35 × 7-8 μm, clavate, 4-spored. *Basidioles* clavate. Lamellar edge sterile; *cheilocystidia* simple, basidiole-like, 13-18 × 3.5-10 μm, cylindrical to clavate, seldom irregular in outline, hyaline, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body (9-)13-23 × 7-13 μm, clavate to broadly clavate or turbinate, often branched, hyaline, inamyloid, thin- to thick-walled; apical setulae 2-12 × 1-1.5 μm, crowded, cylindrical, obtuse to subacute, yellow, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 4-9(-14) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae (4-)6-10 μm diam., parallel, cylindrical, yellow to brownish yellow, smooth, dextrinoid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 6-14 μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* numerous, 23-87 × 6-9 μm, cylindrical to irregular in outline, rarely lobed, hyaline to pale yellow, weakly dextrinoid, thin- to thick-walled (up to 2 μm). *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious, often in caespitose clusters on bamboo debris or seldom on

dicotyledonous leaves or woody debris, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Huai Nam Dang National Park, North 19° 18.3' E 98° 35.8' alt. 1,538 m., 28 June 2004, N. Wannathes 186 (CMU, SFSU); Chiang Rai Province, Muang District, Khun Con Waterfall, 12 June 2005, N. Wannathes 305 (CMU: **holotype**; SFSU: **isotype**).

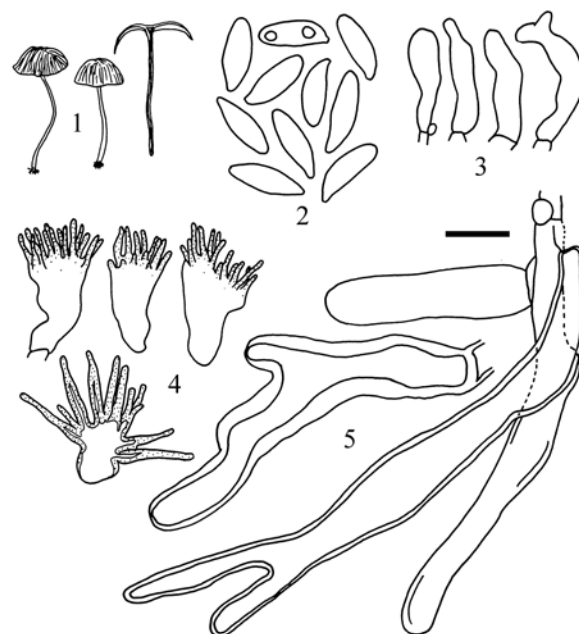


Fig. 40. *Marasmius pseudopellucidus* (N. Wannathes305) 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pileipellis 5. Caulocystidia, Scale bar 1 = 20 mm, 2-5 = 10 μm

Discussion: Basidiomes of *Marasmius pseudopellucidus* look like *M. pellucidus*, and the two species may be confused in the field. *Marasmius pellucidus* is a member of sect. *Globulares* and is characterized by having smooth, clavate to subglobose cells forming the pileipellis, rather than *Siccus*-type broom cells as in *M. pseudopellucidus*. The new Thai species is most similar to two white African species. *Marasmius haediniformis* Singer differs in forming fewer lamellae (12-18 vs 19-22), a stipe colored deep brown at the base, numerous *Siccus*-type cheilocystidia, and lacks caulocystidia (Antonín, 2007). *Marasmius subarborescens* Singer differs in forming smaller basidiospores ($x_m = 6.3 \times 3 \mu\text{m}$ vs $11 \times 4.1 \mu\text{m}$), *Siccus*-type cheilocystidia, and a chestnut brown base stipe (Pegler, 1977; Antonín, 2007). *Marasmius pseudopellucidus* also phenetically similar to two white species

from the neotropics. *Marasmius personatus* Berk. & M.A. Curtis differs in forming a smaller pileus (6-10 mm diam. vs 5-40 mm diam.), a fulvous or dark brown stipe, and has pleurocystidia and *Siccus*-type cheilocystidia (Singer, 1976). *Marasmius pseudoniveus* Singer differs in forming a sulcate pileus, darker stipe (chestnut brown to brown at the base), smaller basidiospores ($8-10.3 \times 2.7-4 \mu\text{m}$), *Siccus*-type cheilocystidia, and three types of pileipellis cells (Singer, 1976).

35. *Marasmius ochroleucus* Desjardin & E. Horak, *Biblio. Mycol.* 168: 35. 1997.

(Fig. 41)

Pileus 11-18 mm diam., convex to plano-convex, umbonate, smooth to striate, pruinose, dull, hygrophanous, disc light yellow (4A2) to cream (4A3-4), margin paler. *Context* off-white, thin. *Lamellae* adnexed, close to crowded (20-24) with 3-4 series of lamellulae, narrow, intervenose, off-white to cream, non-marginate. *Stipe* 35-58 \times 1-1.2 mm, central, cylindrical, hollow, hispidulous, non-insititious, apex off-white to light yellow (4A4), base yellowish orange (4A6) to light brown. *Odor* sweet. *Taste* not distinctive.

Basidiospores 8-12 \times 3.5-4 μm [$x_m = 9.7 \pm 1.0 \times 3.9 \pm 0.2 \mu\text{m}$, $Q = 2.0-3.1$, $Q_m = 2.5$, $n = 25$ spores, $s = 1$ specimen], ellipsoid, curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 12-27 \times 4-6 μm , cylindrical or irregular in outline, hyaline, inamyloid, thin-walled; apical setulae 3-10 \times 1-2 μm , cylindrical, seldom branched, obtuse to subacute, hyaline, thin-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled, composed of *Siccus*-type broom cells; main body 13-20 \times (3-)8-9 μm , clavate to broadly clavate or turbinate, hyaline to pale yellow, inamyloid, thin- to thick-walled; apical setulae 2-7 \times 1 μm , crowded, cylindrical to irregular in outline, obtuse to subacute, yellow, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 3-6 μm diam., interwoven, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 4-10 μm diam., parallel, cylindrical, yellow, smooth, weakly dextrinoid,

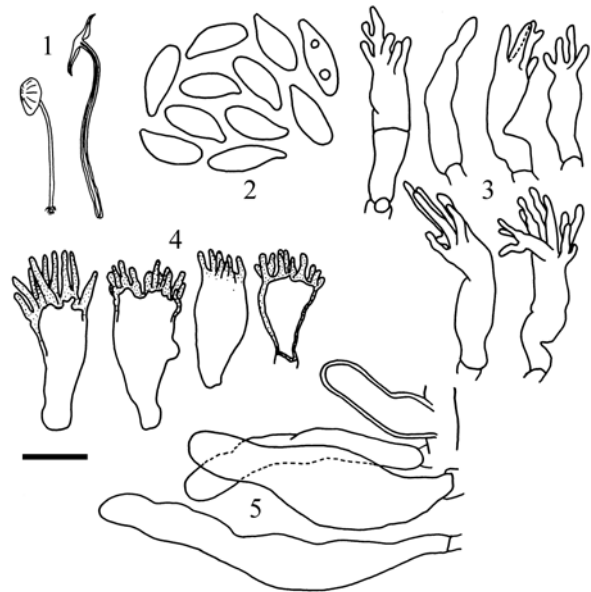


Fig. 41. *Marasmius ochroleucus* (N. Wannathes 299) 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pileipellis 5. Caulocystidia, Scale bar 1 = 20 mm, 2-5 = 10 μm

thin- to thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 6-8(-13) μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous, *Caulocystidia* numerous, 14-53 \times 5-12 μm , cylindrical to fusoid-ventricose or irregular in outline, obtuse, hyaline, inamyloid, thin- to thick-walled. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, New Caledonia and Northern Thailand.

Material examined: Thailand. Chiang Rai Province, Muang District, Khun Con Waterfall, 12 June 2005, N. Wannathes 299 (CMU, SFSU).

Discussion: *Marasmius ochroleucus*, originally described from material collected in New Caledonia, is characterized by a smooth, hygrophanous pileus colored light yellow to cream, close to crowded, emarginate lamellae, a pale yellowish orange to light brown hispidulous stipe, numerous irregularly cylindrical, obtuse, thin-walled caulocystidia, and an absence of pleurocystidia. The Thai material is nearly indistinguishable from the protologue (differing only in forming fewer lamellae) and the species is most phenetically similar to *M. auratus* (described above) and *M. musicolor* Y.S.Tan & Desjardin from Malaysia. *Marasmius auratus* differs in forming a darker, golden yellow pileus, larger basidiospores (x_m

= $12.2 \times 4.1 \mu\text{m}$ vs $9.7 \times 3.9 \mu\text{m}$), and lacks *Siccus*-type cheilocystidia. *Marasmius musicolor* differs in forming larger basidiospores with mean $16.1 \times 3.9 \mu\text{m}$, fewer lamellae (12-14 vs 20-24), and has clustered caulocystidia.

36. *Marasmius luteolus* Berk. & M.A. Curtis, Proc. Amer. Acad. Arts 4: 119. 1860.

(Figs 42, 49-2)

Pileus 4-42 mm diam., convex to plano-convex, expanding to plano-depressed, striate to sulcate, pruinose to minutely velutinous, dull, disc bright brownish orange to golden orange, margin pale cream-orange or paler to yellowish orange. *Context* pale yellow, thin. *Lamellae* adnate, subdistant (8-14) with 2-3 series of lamellulae, narrow (< 4 mm), white to buff, non-marginate, non-intervenose. *Stipe* 10-35 \times 1 mm, central, cylindrical with a subbulbous base, hollow, pruinose, non-insititious, apex yellowish white to buff, base brown. *Odor* and *taste* not distinctive.

Basidiospores 9-12 \times 3.5-5 μm [$x_{\text{mr}} = 9.7-11 \times 3.7-4.3 \mu\text{m}$, $x_{\text{mm}} = 10.2 \pm 0.5 \times 4.1 \pm 0.2 \mu\text{m}$, $Q_{\text{mr}} = 2.4-3.0$, $Q_{\text{mm}} = 2.6 \pm 0.2$, $n = 25$ spores, $s = 6$ specimens], ellipsoid, curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* and *pleurocystidia* similar, common on the sides and edges of lamellae, composed of *Siccus*-type broom cells; main body (9-)12-33 \times (5-)7-10 μm , cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin- to thick-walled; apical setulae 3-12 \times 1-2 μm , cylindrical to conical, wavy in outline, subacute, pale yellow to yellow, thick-walled. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 10-20 \times 6-10 μm , clavate to broadly clavate, hyaline, inamyloid, thin- to thick-walled; apical setulae 3-11 \times 1-2 μm , crowded, cylindrical to conical, wavy in outline, subacute, pale yellow to yellow, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 3-8(-10) μm diam., interwoven, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-12 μm diam., parallel, cylindrical, yellowish brown, smooth, dextrinoid, thick-walled (up to 2 μm), non-gelatinous. *Stipe trama* hyphae 4-

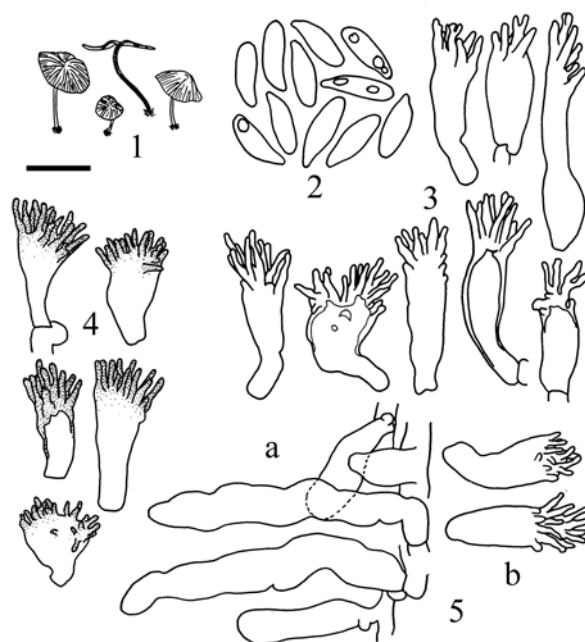


Fig. 42. *Marasmius luteolus* (N. Wannathes 138) 1. Basidiomes 2. Basidiospores 3. Hymenial cystidia 4. Pileipellis 5a. Non-setulose caulocystidia 5b. *Siccus*-type caulocystidia, Scale bar 1 = 20 mm, 2-5 = 10 μm

15 μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* composed of two types of cells: a) *Siccus*-type broom cells with main body 8-18 \times 6-7 μm , scattered, uncommon, cylindrical or irregular in outline, hyaline; apical setulae 2-6 \times 1 μm , cylindrical to conical, wavy in outline, subacute, hyaline to pale-yellow, thick-walled; b) non-setulose cells, common, 11-60 \times 5-10 μm , polymorphic, cylindrical to clavate or irregular in outline, often lobed, obtuse, hyaline, inamyloid, thin- to thick-walled (up to 1 μm). *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on bamboo debris or on dicotyledonous leaves. Japan (Bonin Islands), Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 28 June 2003, N. Wannathes 008 (CMU, SFSU); same location, 28 August 2003, N. Wannathes 138 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Sangasabhasri Land on the way to Huai Kok Ma Village, N 18° 48.4' E 98° 54.6' alt. 1,146 m., 29 August 2003, N. Wannathes 143 and N. Wannathes 144 (CMU, SFSU); Chiang Mai Province, Huai Nam Dang National Park, North 19° 18.3' E 98° 35.8' alt. 1,538 m., 28 June 2004, N. Wannathes 185 (CMU, SFSU); Chiang Rai Province, Muang District, Khun Con Waterfall, 12 June 2005, N. Wannathes 304 (CMU, SFSU).

Discussion: *Marasmius luteolus* is characterized in forming striate to sulcate pilei colored pale cream-orange to yellowish orange with bright brownish orange to golden orange disc, subdistant, narrow lamellae, a relatively short (10-35 mm), pruinose stipe covered with two types of caulocystidia (*Siccus*-type broom cells and non-setulose cells), medium-sized basidiospores, and growth on monocotyledonous and dicotyledonous debris. A distinctive feature of *M. luteolus* are pleurocystidia of *Siccus*-type broom cells, a feature rare in *Marasmius*. The type was collected on palm leaves in the Bonin Islands (isotype FH!) and this is the first report of the species outside of Japan. *Marasmius luteolus* is similar to *M. setulosifolius* Singer, another species with *Siccus*-type pleurocystidia, but the latter species differs in lacking simple, non-setulose caulocystidia (Singer, 1976).

37. *Marasmius jasminodorus* Wannathes, Desjardin & Lumyong, sp. nov.

(Figs 43, 49-4)

MycoBank: 512421

Etymology: ‘*jasmin*’ = jasmine, ‘*odorus*’ = odor, referring to the jasmine tea odor of the basidiomes.

Pileus 10-40 mm diametro, late convexus usque campanulatus, interdum umbone parvo, pruinosis, hebetatus, disco ruguloso, rubro-atrobrunneo, margine ruguloso-striato, laete brunneo usque brunneo-aurantiaco. *Contextus* flavo-albus, tenuis. *Lamellae* annexae, subdistantes (12-17) cum 3-4 seriebus lamellarum, latae (2-5 mm), pallide flavo-albae, haud marginatae vel pallide brunneo-aurantiacomarginatae, haud intervenosae. *Stipes* 20-60 × 1-2 mm, centralis, cylindratus, tenax, cavus, glaber usque minute velutinus, haud insititius, mycelio strigosum et brunneo-aurantiacum ad basim, apice pallide flavo-albo, basi brunnea usque rubro-brunnea vel rubro-atrobrunnea. *Odor* fortis, suavis et fragrans, iasmino sicco similis. *Sapor* leviter amarus. *Basidiosporae* 9-12(-14) × 3-4(-4.5) μm, ellipsoideae, oblique curvae, laeves, hyalinae, inamyloideae, tenuitunicatae *Basidia* 23-25 × 5-6 μm, cylindrata usque clavata, 4-spora. *Basidiolae* fusioideae usque clavatae. *Cheilocystidia* vulgaria, typi *Sicci*; 9-19(26) × 6-10 μm, cylindrata usque clavata, hyalina usque pallide flava, inamyloidea, tenui- usque crassetunicata; setulis apicalibus (2-)4-9(-11) × 1-2 μm, cylindratis vel adumbratim inaequabilibus, obtusis usque subacutis, flavis usque brunneo-flavis, crassetunicatis. *Pleurocystidia* nulla. *Pileipellis* hymeniformis, maculosus, typi *Sicci*; 10-23(-29) × 6-9(-15) μm, clavatus usque late clavatus, saepe ramosus, hyalinus, inamyloideus, tenui- usque crassetunicatus; setulis apicalibus (2-)4-9(-15) × 1-2(-3) μm, coartatis, cylindratis vel adumbratim inaequabilibus, saepe ramosis, obtusis usque subacutis,

flavo-brunneis usque brunneis, crassetunicatis. *Trama pilei* intertexta, fortiter dextrinoidea. *Trama lamellae* intertexta, hyphis (4-)8-15(-25) μm diametro, cylindratis usque inflatis, laevibus, hyalinis, fortiter dextrinoideis, tenuitunicatis, haud gelatinosis. *Stipitipellis* parallelus, hyphis (3-)5-8 μm diametro, cylindratis, flavo-brunneis usque brunneis, laevibus, dextrinoideis, crassetunicatis (usque ad 1 μm), haud gelatinosis. *Trama stipitis* parallela, hyphis 4-8 μm diametro, cylindratis, hyalinis, laevibus, dextrinoideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* 2 typorum: a) cellulis typi *Sicci* (5-)15-25 × 4-7 μm, dispersis, raris, cylindratis vel adumbratim inaequabilibus, hyalinis; setulis apicalibus (2-)4-11 × 1-1.5 μm, cylindratis usque conicis vel undulatis, pallide flavis, tenui- usque crassetunicatis; b) cellulis haud setulosis, abundantia, 11-42 × 4-10 μm, cylindratis vel adumbratim inaequabilibus, raro ramosis, obtusis usque subacutis, hyalinis, inamyloideis, tenui- usque crassetunicatis (usque ad 1 μm). *Fibulae* praesentes in omnibus texturis.

Typus: Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., dispersus usque gregarius in folis plantae dicotyledoneae vel ligno, 1 August 2003, N. Wannathes 067 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 10-40 mm diam., broadly convex to campanulate, sometimes with a small umbo, pruinose, dull; disc rugulose, dark reddish brown (7-8D6-8); margin rugulose-striate, light brown to brownish orange (7C6-8). *Context* yellowish white, thin. *Lamellae* narrowly adnexed, subdistant (12-17) with 3-4 series of lamellulae, broad (2-5 mm), pale yellowish white, non-marginate or with pale brownish orange edges, non-intervenose. *Stipe* 20-60 × 1-2 mm, central, cylindrical, tough, hollow, glabrous to minutely velutinous, non-insititious, base with strigose, brownish orange mycelium; apex pale yellowish white (4A2), base brown (7E7-8) to reddish brown (8E7-8) or dark reddish brown (8F5-8). *Odor* strong, sweet and fragrant, like jasmine tea. *Taste* mildly bitter.

Basidiosporae 9-12(-14) × 3-4(-4.5) μm [$x_{mr} = 9.4-11.5 \times 3.1-4.1 \mu m$, $x_{mm} = 10.1 \pm 0.5 \times 3.6 \pm 0.3 \mu m$, $Q_{mr} = 2.6-3.4$, $Q_{mm} = 2.8 \pm 0.1$, $n = 25$ spores, $s = 18$ specimens], ellipsoid, curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* 23-25 × 5-6 μm, cylindrical to clavate, 4-spored. *Basidioles* fusoid to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 9-19(-26) × 6-10 μm, cylindrical to clavate, hyaline to pale yellow, inamyloid, thin- to thick-walled; apical setulae (2-)4-9(-11) × 1-2 μm, cylindrical or irregular in outline, obtuse to subacute, yellow to brownish yellow, thick-walled.

Pleurocystidia absent. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 10-23(-29) × 6-9(-15) μm, clavate to broadly clavate, often branched, hyaline, inamyloid, thin- to thick-walled; apical setulae (2-)4-9(-15) × 1-2(-3) μm, crowded, cylindrical to irregular in outline, often branched, obtuse to subacute, yellowish brown to brown, thick-walled. *Pileus trama* interwoven, strongly dextrinoid. *Lamellar trama* hyphae (4-)8-15(-25) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae (3-)5-8 μm diam., parallel, cylindrical, yellowish brown to brown, smooth, dextrinoid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 4-8 μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* composed of two types of cells: a) *Siccus*-type broom cells with main body (5-)15-25 × 4-7 μm, scattered, uncommon, cylindrical or irregular in outline, hyaline; apical setulae (2-)4-11 × 1-1.5 μm, cylindrical to conical or wavy, pale yellow, thin- to thick-walled; b) abundant non-setulose cells, 11-42 × 4-10 μm, cylindrical or irregular in outline, seldom branched, obtuse to subacute, hyaline, inamyloid, thin- to thick-walled (up to 1 μm). *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves or on wood, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 28 June 2003, D.E. Desjardin 7589 (CMU, SFSU); same location, 25 July 2003, N. Wannathes 028 (CMU, SFSU); same location, 1 August 2003, N. Wannathes 067 (CMU: **holotype**; SFSU: **isotype**); same location, 29 June 2004, Y.S. Tan 283 (CMU, SFSU); same location, 2 August 2004, N. Wannathes 219 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, "Water Conservation Area" Highway 1,095 at 22 km marker, N. 19° 7.5' E 98° 45.7' alt. 724 m., 2 July 2003, D.E. Desjardin 7604 (CMU, SFSU); same location, 4 August 2003, N. Wannathes 084 (CMU, SFSU); same location, 2 June 2004, N. Wannathes 169 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Mushroom Research Centre, 27 km marker on Hwy 1095, 9 June 2004, N. Wannathes 151 (CMU, SFSU); Chiang Mai Province, Doi Inthanon National Park, At 25 km marker on Highway 1,009, N 18° 32.5' E 98° 33.5' alt. 1,076 m., 10 June 2004, N. Wannathes 156 (CMU, SFSU); same

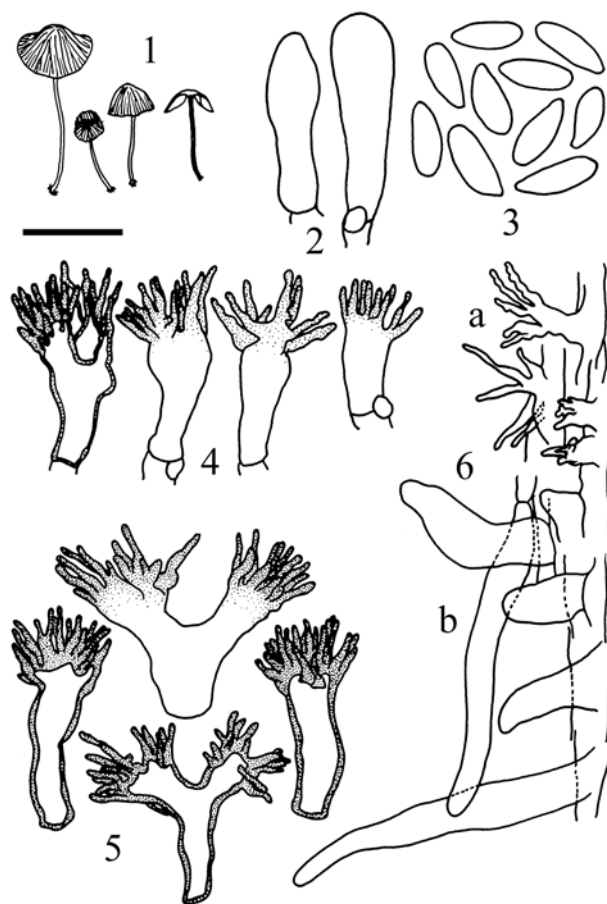


Fig. 43 *Marasmius jasminodoros* (N. Wannathes067) 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5. Pileipellis 6a. *Siccus*-type caulocystidia 6b. Caulocystidia, Scale bar 1 = 20 mm, 2-6 = 10 μm

location, 25 June 2004, N. Wannathes 172 (CMU, SFSU); same location, 27 June 2005, N. Wannathes 365 (CMU, SFSU); Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., 3 July 2004, N. Wannathes 210 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, trail to 9 channel station, 24 July 2004, N. Wannathes 238 (CMU, SFSU); Chiang Rai Province, Khun Chae National Park, N 19° 4.4' E 99° 23.5' alt. 963 m., 10 June 2005, N. Wannathes 287 (CMU, SFSU); Chiang Rai Province, Muang District, Doo Village, Pong Prabath Waterfall, N 19° 53.2' E 100° 07.3' alt. 408 m., 11 June 2005, N. Wannathes 294 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, the trail opposite with the way to Huai Kok Ma Village, 2 July 2005, N. Wannathes 387 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Sri Lanna National Park, near Mae Ngad Dam, 9 August 2005, N. Wannathes 404 (CMU, SFSU); Phrae Province, Muang District, Cherng Thong Waterfall, 16 August 2005, N. Wannathes 414 (CMU, SFSU).

Discussion: Distinctive features of this new species include the following: a rugulose-striate pileus colored light brown to brownish

orange on the margin with dark reddish brown disc; subdistant (12-17), broad, pale yellowish white lamellae; basidiospores with mean $10.1 \times 3.6 \mu\text{m}$; and two types of caulocystidia, *Siccus*-type broom cells and simple cylindrical non-setulose cells. A most remarkable feature is the strong, sweet and fragrant odor like jasmine tea, unknown in any other *Marasmius* species. *Marasmius jasminodorus* is very similar to *M. araucariae* Singer described from material collected in Argentina, but the latter species differs in forming longer subcylindrical caulocystidia, more numerous lamellae (16-24) and lacks *Siccus*-type broom cells on the stipe surface and lacks a fragrant odor (Singer, 1976). *Marasmius jasminodorus* is also phenetically similar to *M. araucariae* var. *siccipes* described from Java, but the latter species differs in forming a more brownish orange pileus that is not rugulose overall, darker coloured lamellae (brownish orange to greyish brown) and lacks a fragrant odor (Desjardin *et al.*, 2000).

38A. *Marasmius araucariae* Singer var. *araucariae*, Sydowia 18: 333. 1965. (Fig. 44)

Pileus 9-34 mm diam., convex to plano-convex, slightly depressed in age, pruinose, dull; disc rugulose, reddish brown; margin striate, brownish orange. *Context* off-white, thin. *Lamellae* narrowly adnate, subdistant (14-15) with 3-4 series of lamellulae, broad (1-3 mm), cream, non-marginate, non-intervenose. *Stipe* 30-45 \times 1-1.2 mm, central, cylindrical, hollow, subvelutinous, non-insititious, apex off-white, base brown. *Odor* and *taste* not distinctive.

Basidiospores 9-11(-12) \times 3-4 μm [$x_m = 10.5 \pm 0.8 \times 3.9 \pm 0.3 \mu\text{m}$, $Q = 2.3-3.1$, $Q_m = 2.7$, $n = 25$ spores, $s = 1$ specimen], ellipsoid, curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 11-15 \times 5-7 μm , subcylindrical to clavate or irregular in outline, seldom lobed, hyaline, inamyloid, thin-walled; apical setulae 3-8 \times 1-2 μm , cylindrical to conical, sometimes wavy in outline, obtuse to subacute, yellow to brownish yellow, thin-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 12-21 \times 7-12 μm ,

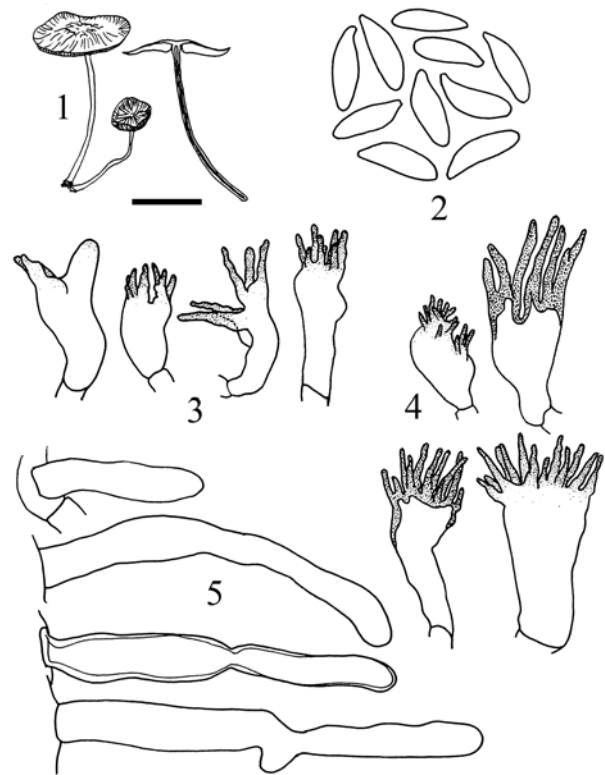


Fig. 44. *Marasmius araucariae* var. *araucariae* (N. Wannathes 300) 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pileipellis 5. Caulocystidia, Scale bar 1 = 20 mm, 2-5 = 10 μm

clavate to broadly clavate, turbinate or irregular in outline, hyaline, inamyloid, thin- to thick-walled; apical setulae 3-13 \times 1-1.5 μm , crowded, cylindrical to irregular in outline, obtuse to subacute, brownish yellow, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 4-10(-16) μm diam., interwoven, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 4-8 μm diam., parallel, cylindrical, yellowish brown, smooth, dextrinoid, thin- to thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 6-13 μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* numerous, 24-60 \times 5-8 μm , polymorphic, cylindrical to clavate or irregular in outline, obtuse, hyaline, inamyloid, thin- to thick-walled (up to 1.5 μm); *Siccus*-type broom cells absent on stipe surface. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious, often in cespitose clusters on dicotyledonous leaves. Argentina, Northern Thailand, Papua New Guinea.

Material examined: Thailand. Chiang Rai Province, Muang District, Khun Con Waterfall, 12 June 2005, N. Wannathes 300 (CMU, SFSU).

Discussion: *Marasmius araucariae* is characterized by rugulose pilei coloured reddish brown to brownish orange, subdistant (14-15), broad, cream-coloured and non-marginate lamellae, a brown, subvelutinous stipe that often develops in cespitose clusters, basidiospores with mean $10.5 \times 3.9 \mu\text{m}$, simple, cylindrical caulocystidia, and an absence of pleurocystidia. The Thai specimen matches nicely with the material that was reported from Papua New Guinea (Desjardin & Horak, 1997). It is similar to *M. araucariae* var. *siccipes* (see below) except for lacking *Siccus*-type broom cells on the stipe surface. *Marasmius araucariae* is also phenetically similar to *M. iras* Y.S. Tan & Desjardin described from Malaysia, but the latter species differs in forming larger basidiospores with mean $14.1 \times 3.7 \mu\text{m}$, and broader caulocystidia (6-10 μm diam.).

38B. *Marasmius araucariae* var. *siccipes* Desjardin, Retn. & E. Horak, *Sydowia* 52: 173. 2000. (Figs 45, 49-4)

Pileus 10-33 mm diam., convex to campanulate when young, expanding to plano-convex with upturned margin in age, striate to subsulcate, pruinose, dull; disc dark brown (7F7-9F4), margin brown (6E8) to brownish orange (6C6). *Context* thin, greyish orange (6B4) to light brown (6D5). *Lamellae* adnexed to adnate, subdistant to close (13-20) with 3-4 series of lamellulae, broad (2-4 mm), brownish orange (5C4) to greyish brown, non-marginate, non-intervenose. *Stipe* 13-82 \times 1-2 mm, central, cylindrical, hollow, pruinose to subglabrous, non-insititious, brown to dark brown overall. *Odor* and *taste* not distinctive.

Basidiospores (8-)9-12 \times 3.5-4 μm [$x_{\text{mr}} = 9.8-11.3 \times 3.3-4.0 \mu\text{m}$, $x_{\text{mm}} = 10.4 \pm 0.8 \times 3.6 \pm 0.4 \mu\text{m}$, $Q_{\text{mr}} = 2.8 - 3.1$, $Q_{\text{mm}} = 2.9 \pm 0.2$, $n = 25$ spores, $s = 3$ specimens], ellipsoid, curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 11-18(-28) \times 5-9 μm , subcylindrical to clavate or irregular in outline, seldom lobed, hyaline, inamyloid, thin-walled; apical setulae 3-8 \times 1-2 μm , cylindrical

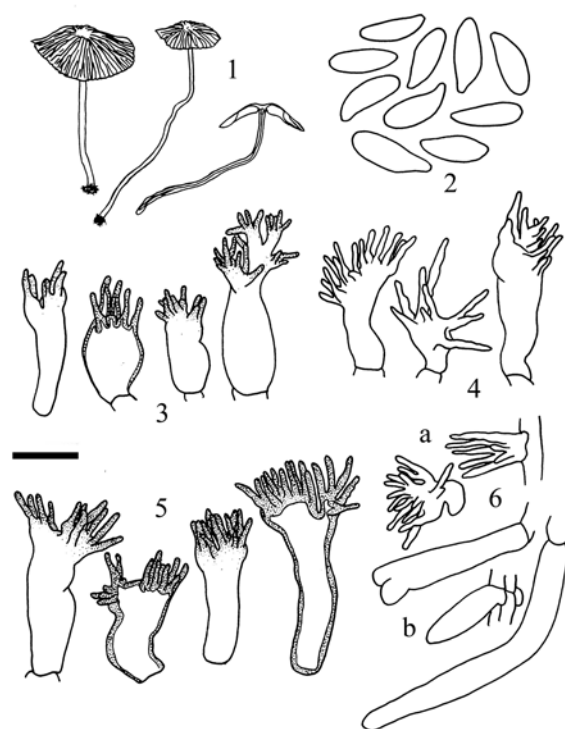


Fig. 45. *Marasmius araucariae* var. *siccipes* (N. Wannathes 364) 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pleurocystidia 5. Pileipellis 6a. *Siccus*-type caulocystidia 6b. Caulocystidia, Scale bar 1 = 20 mm, 2-6 = 10 μm

to conical, sometimes wavy in outline, obtuse to subacute, light brown to brownish yellow, thin-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body (9-)14-26 \times 7-10 μm , clavate to broadly clavate, turbinate or irregular in outline, hyaline, inamyloid, thin- to thick-walled; apical setulae (2-)4-10 \times 1-2 μm , crowded, cylindrical to irregular in outline, obtuse to subacute, brown to dark brown, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae (3-)5-12 μm diam., interwoven, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 4-10 μm diam., parallel, cylindrical, yellowish brown to brown, smooth, dextrinoid, thick-walled (up to 1.5 μm), non-gelatinous. *Stipe trama* hyphae 6-14 (-20) μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* composed of two types of cells: a) *Siccus*-type broom cells with main body 3-12 \times 4-7 μm , scattered, uncommon, cylindrical or irregular in outline, hyaline; apical setulae 4-11 \times 1-1.5 μm , cylindrical to conical or wavy, pale-yellow, thin-walled; b) abundant non-

setulose cells, 13-40 × 4-6 μm, polymorphic, cylindrical to clavate or irregular in outline, sometimes branched, obtuse, hyaline, inamyloid, thin- to thick-walled (up to 1 μm). *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to solitary on dicotyledonous leaves, Java, Malaysia and Northern Thailand.

Material examined: Thailand, Chiang Mai Province, Mae Taeng District, Tung Joaw Village, N 19° 8.07' E 98° 38.9' alt. 1423 m, 30 August 2003, N. Wannathes 146 (CMU, SFSU); Chiang Mai Province, Doi Inthanon National Park, At 25 km marker on Highway 1,009, N 18° 32.5' E 98° 33.5' alt. 1,076 m, 25 June 2004, N. Wannathes 173 (CMU, SFSU); same location, 27 June 2005, N. Wannathes 364 (CMU, SFSU).

Discussion: This variety described by Desjardin *et al.* (2000) from Java differs from the type variety in forming numerous *Siccus*-type broom cells on the stipe surface amongst the simple, cylindrical caulocystidia. The Thai populations are micromorphologically indistinguishable from the populations in Malaysia and Java, and differ only subtly in forming darker brown pilei with brown orange to greyish brown lamellae. At present, these color difference do not appear significant enough to recognize the Thai entity as a distinct taxon.

39. *Marasmius xestocephalus* Singer, Bull. Jard. Bot. Etat Brux. 34: 367. 1964. (Fig. 46)

Pileus 5-23 mm diam., convex to plano-convex, umbonate, striate to pellucid-striate, pruinose, dull, disc yellowish brown (6D8), margin greyish yellow (4B4-5) to yellowish orange (4B7). *Context* pale yellow, thin. *Lamellae* adnexed to adnate, subdistant (15-18) with 3-4 series of lamellulae, narrow, pale yellow with or without light orangish brown edges, non-intervenose. *Stipe* 18-35 × 0.5-1 mm, central, cylindrical, hollow, pubescent to subvelutinous, non-insititious, apex light yellow (3A4), base light brown (6D6) to reddish brown (8E7). *Odor* and *taste* not distinctive.

Basidiospores (10-)11-14(-15) × 3-4 μm [$x_{mr} = 11.8-13 \times 3.5-3.8 \mu\text{m}$, $x_{mm} = 12.5 \pm 0.6 \times 3.7 \pm 0.2 \mu\text{m}$, $Q_{mr} = 3.4$, $Q_{mm} = 3.4 \pm 0.0$, $n = 25$ spores, $s = 3$ specimens], ellipsoid to fusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, of *Siccus*-type broom cells; main body 10-18 × 6-9 μm,

cylindrical to clavate, broadly clavate or irregular in outline, often lobed, hyaline, inamyloid, thin-walled; apical setulae 3-10 × 1-1.5 μm, cylindrical, obtuse to subacute, pale yellow to yellow, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled to non-mottled, composed of *Siccus*-type broom cells; main body (9-)12-24 × 5-11 μm, clavate to broadly clavate, often branched, hyaline, inamyloid, thin-walled; apical setulae 2-5 × 1-1.5 μm, crowded, cylindrical, obtuse to subacute, yellowish brown, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 3-10 μm diam., interwoven,

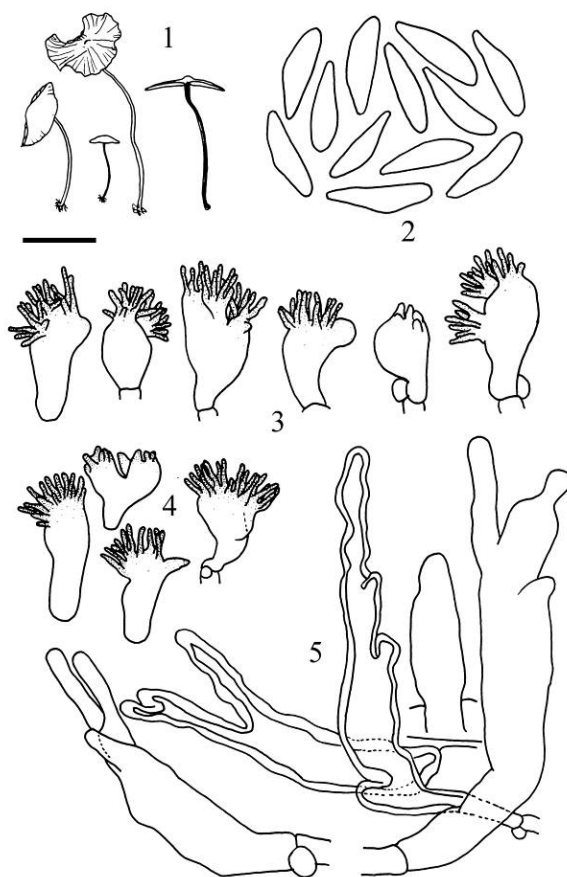


Fig. 46. *Marasmius xestocephalus* (N. Wannathes 344) 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pileipellis 5. Caulocystidia, Scale bar 1 = 20 mm, 2-5 = 10 μm

cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae (2-)4-8 μm diam., subparallel, cylindrical, brown to yellowish brown, smooth, weakly dextrinoid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 3-8(-10) μm diam., subparallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* numerous, usually apically forked;

main body 25-54 × 6-10 μm, cylindrical to irregular in outline, hyaline to pale yellow, weakly dextrinoid, thin- to thick-walled (up to 1 μm); apical fork 10-20 × 4-7 μm, cylindrical, obtuse, hyaline to pale yellow, thin- to thick-walled; *Siccus*-type broom cells absent on stipe surface. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, Africa and Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Mae Taeng District, "Water Conservation Area" Highway 1,095 at 22 km marker, N. 19° 7.5' E 98° 45.7' alt. 724 m., 5 July 2004, Y.S. Tan 313 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 7 July 2004, J.F. Kerekes 69 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Mae Sae Village, Pang Sa Ded Water Conservation Area, N 19° 14.6', E 98° 38.5' alt. 962 m., 26 June 2005, N. Wannathes 344 (CMU, SFSU).

Discussion: Diagnostic features of *Marasmius xestocephalus* include: a greyish yellow to yellowish orange pileus with yellowish brown disc; subdistant (15-18), narrow, pale yellow lamellae; a pubescent to subvelutinous stipe; fusoid basidiospores with mean 12.5 × 3.7 μm; and apically forked caulocystidia. The Thai material is indistinguishable from the protologue (Singer, 1964) and redescription of *M. xestocephalus* by Pegler, (1977), and differs only slightly from the recent description provided by Antonín (2007) who reported broader basidiospores (4.5-5.5 μm diam.). Until further material of this species is collected, sequenced and compared with Thai specimens, we tentatively recognize our species as *M. xestocephalus*.

40. *Marasmius iras* Y.S. Tan & Desjardin *Fungal Diversity* 37: 61, 2009 (Figs 47, 49-6)

Pileus 5-20 mm diam., convex when young, expanding to plano-convex with slightly depressed disc in age, striate to sulcate, pruinose, dull, dark yellowish brown (5F8-5E6) to dark brown (6E8). *Context* yellowish brown (5E8), thin. *Lamellae* adnexed to adnate, subdistant (12-17) with 3 series of lamellulae, narrow, cream brown to brownish orange (5C5) with brown edges, non-intervenose. *Stipe* 17-43 × 0.5-1 mm, central, cylindrical, hollow, subvelutinous, non-insititious, apex yellowish

white (3A2), base reddish brown (8E7). *Odor* and *taste* not distinctive.

Basidiospores (11-)12-14(-15) × 3-4(-5) μm [$x_{mr} = 12.6-13.4 \times 3.4-4.2$, $x_{mm} = 12.8 \pm 0.5 \times 3.7 \pm 0.4$ μm, $Q_{mr} = 3.0-3.7$, $Q_{mm} = 3.5 \pm 0.4$, $n = 25$ spores, $s = 3$ specimens], fusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body (8-)13-21 × 5-7(-10) μm, cylindrical to clavate or irregular in outline, seldom branched, hyaline, inamyloid, thin-walled; apical setulae (2-)4-9(-11) × 1-1.5(-2) μm, cylindrical, obtuse to subacute, yellow to brown, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, mottled to weakly mottled, composed of *Siccus*-type broom cells; main body 12-25 × 5-9 μm, cylindrical to clavate or turbinate, seldom branched, hyaline, inamyloid, thin-walled; apical setulae 3-8 × 1 μm, crowded, cylindrical to irregular in outline, obtuse to subacute, dark brown to black, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 3-8(-10) μm diam., interwoven, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-7(-10) μm diam., subparallel, cylindrical, yellow to brown, smooth, inamyloid to weakly dextrinoid, thick-walled

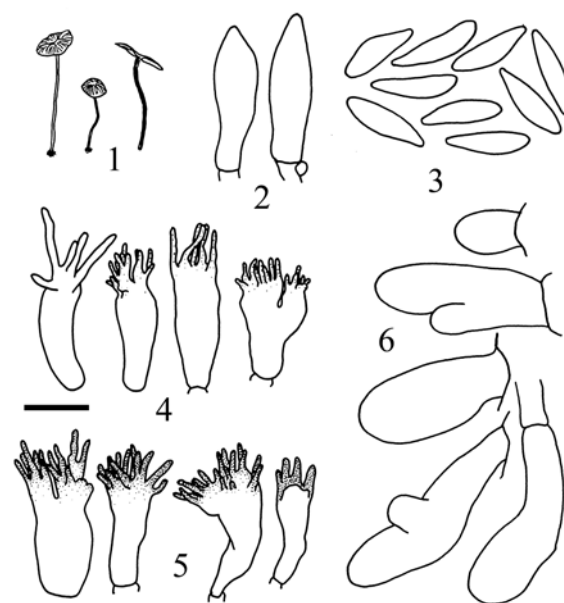


Fig. 47. *Marasmius iras* (N. Wannathes 276) 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5. Pileipellis 6. Caulocystidia, Scale bar 1 = 20 mm, 2-6 = 10 μm

(up to 1 μm), non-gelatinous. *Stipe trama* hyphae 4-10(-13) μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* numerous, 23-43 \times 6-10 μm , cylindrical to clavate or irregular in outline, rarely lobed, hyaline, inamyloid, thin-walled; *Siccus*-type broom cells absent on stipe surface. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to solitary on dicotyledonous leaves, Malaysia and Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Mae Taeng District, Tung Joaw Village, N 19° 8.07' E 98° 38.9' alt. 1423 m., 30 August 2003, N. Wannathes 147 (CMU, SFSU); same location, 22 August 2004, N. Wannathes 276 (CMU, SFSU); Chiang Mai Province, Huai Nam Dang National Park, North 19° 18.3' E 98° 35.8' alt. 1,538 m., 29 June 2005, N. Wannathes 375 (CMU, SFSU).

Discussion: *Marasmius iras*, described from specimens collected in Malaysia, is characterized by a yellowish brown pileus with dark brown disc, subdistant, yellowish white lamellae, a subvelutinous stipe, fusoid basidiospores, non-setulose caulocystidia, and an absence of pleurocystidia and *Siccus*-type broom cells on the stipe surface. The Thai specimens match quite closely the Malaysian type except for having slightly smaller basidiospores with mean 12.8 \times 3.7 μm vs. 14.1 \times 3.7 μm , and longer setulae of cheilocystidia (4-11 μm vs 4-7 μm long). *Marasmius iras* is phenetically similar to *M. xestocephalus* (see above), but the latter species differs in forming pilei with yellow tones and apically forked, thicker-walled caulocystidia.

41. *Marasmius inthanonensis* Wannathes, Desjardin & Lumyong, **sp. nov.**

(Figs 48, 49-7)

MycoBank: 512422

Etymology: 'inthanon' referring to Doi Inthanon National Park, the site where the holotype specimen was collected.

Pileus 7-42 mm diametro, convexus ubi juvenis, expansus et plano-convexus, disco leviter depresso et margine reflexo ubi vetus, laevis usque striatus, pruinosis, hebetatus, primo olivaceo-brunneus demum brunneo-aurantiacus usque flavo-brunneus. *Contextus* pallide aurantiacus usque adnatae, arctae (12-20) cum 3-4 seriebus lamellularum, latae (3-6 mm), pallide flavae usque flavo-cinereae, laete brunneomarginatae, haud intervenosae. *Stipes* 40-102 \times 1-3 mm, centralis,

cylindratus, cavus, subvelutinus usque hispidulus, haud insititius, apice flavo-albo, basi rubro-atrobrunnea. *Odor saporeque* non propria. *Basidiosporae* 8-12 \times 3-4 μm , ellipsoideae usque fusoideae, oblique curvae, laeves, hyalinae, inamyloideae, tenuitunicatae *Basidia* non observata. *Basidiolae* fusoideae usque clavatae. *Cheilocystidia* vulgaris, typi *Sicci*; 13-23 \times 4-9 μm , subcylindrata usque clavata vel adumbratim inaequabilia, raro ramosa, hyalina, inamyloidea, tenuitunicata; setulis apicalibus 2-6 \times 1-1.5 μm , cylindratis usque conicis, raro ramosis, obtusis usque subacutis, hyalinis usque flavis, tenuitunicatis. *Pleurocystidia* nulla. *Pileipellis* hymeniformis, maculosus, typi *Sicci*; 15-23 \times 6-11 μm , clavatus usque late clavatus, turbinatus vel adumbratim inaequabilis, hyalinus, inamyloideus, tenui- usque crassetunicatus; setulis apicalibus 3-5 \times 1 μm , coartatis, cylindratis vel adumbratim inaequabilibus, obtusis usque subacutis, flavis usque brunneo-flavis, crassetunicatis. *Trama pilei* intertextata, dextrinoidea. *Trama lamellae* intertextata, hyphis (3-)9-13 μm diametro, cylindratis, laevibus, hyalinis, dextrinoideis, tenuitunicatis, haud gelatinosis. *Stipitipellis* subparallelus, hyphis 4-6(-9) μm diametro, cylindratis, brunneis usque olivaceo-brunneis, laevibus, inamyloideis usque leniter dextrinoideis, crassetunicatis (usque ad 1 μm), haud gelatinosis. *Trama stipitis* parallela, hyphis 4-13 μm diametro, cylindratis, hyalinis, laevibus, dextrinoideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* numerosa, 24-48 \times 6-8 μm , cylindrata, adumbratim inaequabilia, hyalina, inamyloidea, tenui- usque crassetunicata; sine cellulis type *Sicci* super superficiem stipitis. *Fibulae* praesentes in omnibus texturis.

Typus: Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., dispersus usque gregarius in folis plantae dicotyledoneae, 27 June 2005, N. Wannathes 353 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 7-42 mm diam., convex when young, expanding to plano-convex with a slightly depressed disc and reflexed margin in age, smooth to striate, pruinose, dull, at first olive brown overall, fading through brownish orange (5C4-5) to yellowish brown (5E4-5) in age. *Context* pale orange (5A3) to greyish brown (5E3), thin. *Lamellae* adnexed to adnate, close (12-20) with 3-4 series of lamellulae, broad (3-6 mm), pale-yellow to yellowish grey (3B2) with light brown edges, non-intervenose. *Stipe* 40-102 \times 1-3 mm, central, cylindrical, hollow, subvelutinous to hispidulous, non-insititious, apex yellowish white, base dark reddish brown. *Odor* and *taste* not distinctive.

Basidiospores 8-12 \times 3-4 μm [$x_{\text{mr}} = 9.8-10.9 \times 3.9-4.0$, $x_{\text{mm}} = 10.3 \pm 0.8 \times 3.9 \pm 0.1 \mu\text{m}$, $Q_{\text{mr}} = 2.5 - 2.7$, $Q_{\text{mm}} = 2.6 \pm 0.1$, $n = 25$ spores, $s = 2$ specimens], ellipsoid to fusoid, curved in profile, smooth, hyaline, inamyloid, thin-

walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 13-23 × 4-9 μm, subcylindrical to clavate or irregular in outline, seldom branched, hyaline, inamyloid, thin-walled; apical setulae 2-6 × 1-1.5 μm, cylindrical to conical, seldom branched, obtuse to subacute, hyaline to yellow, thin-

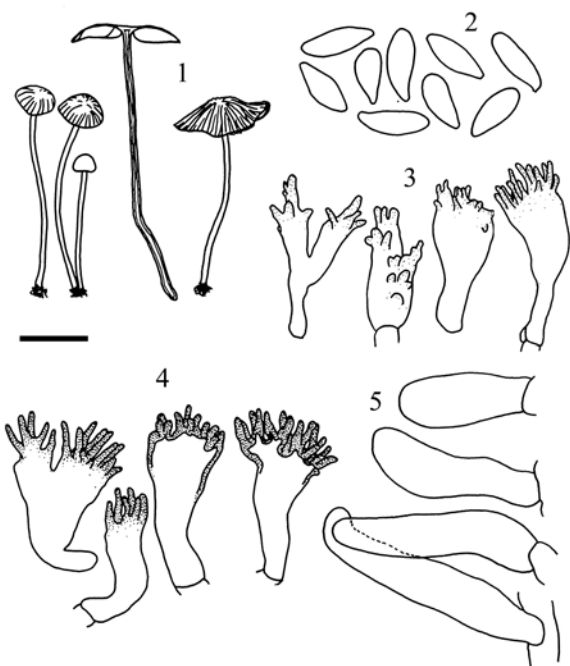


Fig. 48. *Marasmius inthanonensis* (N. Wannathes 353) 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pileipellis 5. Caulocystidia, Scale bar 1 = 20 mm, 2-5 = 10 μm

walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 15-23 × 6-11 μm, clavate, to broadly clavate, turbinate or irregular in outline, hyaline, inamyloid, thin- to thick-walled; apical setulae 3-5 × 1 μm, crowded, cylindrical to irregular in outline, obtuse to subacute, yellow to brownish yellow, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae (3-)9-13 μm diam., interwoven, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 4-6(-9) μm diam., subparallel, cylindrical, brown to olive brown, smooth, inamyloid to weakly dextrinoid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 4-13 μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* nu-

merous, 24-48 × 6-8 μm, cylindrical, irregular in outline, hyaline, inamyloid, thin- to thick-walled; *Siccus*-type broom cells absent on stipe surface. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., 25 June 2004, N. Wannathes 177 (CMU, SFSU); same location, 27 June 2005, N. Wannathes 353 (CMU: **holotype**; SFSU: **isotype**).

Discussion: Diagnostic features of *Marasmius inthanonensis* include: a smooth pileus colored olive brown when young and fading thru brownish orange to yellowish brown in age; close (12-20), broad (3-6 mm), yellowish grey lamellae with light brown edges; a subvelutinous to hispidulous stipe; basidiospores with mean 10.3 × 3.9 μm; and relatively short subcylindrical caulocystidia (up to 48 μm long) and an absence of *Siccus*-type broom cells on the stipe surface. This new species is distinct from all other described species in ser. *Atrorubentes* in having a pileus with olive tones. Phenetically similar species include *M. auratus* (No. 33), *M. ochroleucus* (No. 35), and *M. araucariae* var. *siccipes* (No. 38B). *Marasmius auratus* differs in forming a golden pileus that lacks olive tones, slightly larger basidiospores with mean 12.2 × 4.1 μm, only cylindrical cheilocystidia, and longer caulocystidia (up to 112 μm long). *Marasmius ochroleucus* differs primarily in forming a paler pileus that is light yellow to cream and lacks olive tones; basidiospores size and cysitidia are indistinguishable. *Marasmius araucariae* var. *siccipes* differs in lacking olive tones on the pileus, and forms brown lamellae and two types of caulocystidia. ITS sequence data confirm the distinction of these four species.

Section *Sicci*, subsect. *Siccini*, ser. *Leonini* Singer, Fl. Neotrop. Monogr. 17: 160. 1976.

Type: *Marasmius leoninus* Berk.

42. *Marasmius cremeus* Wannathes, Desjardin & Lumyong, Mycol. Res. 111: 993. 2007.

(Figs 50, 57-1)



Fig. 49. Basidiomata of *Marasmius* section *Sicci* ser. *Atrorubentes*. 1. *M. auratus* (N. Wannathes 351) 2. *M. luteolus* (N. Wannathes 304) 3. *M. pseudopellucidus* (N. Wannathes 305) 4. *M. jasminodorus* (N. Wannathes 414) 5. *M. araucariae* var. *siccipes* (N. Wannathes 364) 6. *M. iras* (N. Wannathes 276) 7. *M. inthanonensis* (N. Wannathes 353), Scale bars = 20 mm

Pileus 3-14 mm diam., obtusely conical when young, expanding to convex, plano-convex or applanate with or without a broad, rugulose umbo in age; margin striate to sulcate; surface dull, dry, glabrous; cream (4A3) overall when young, in age disc cream (4A3) to light yellow (4A2), margin white,

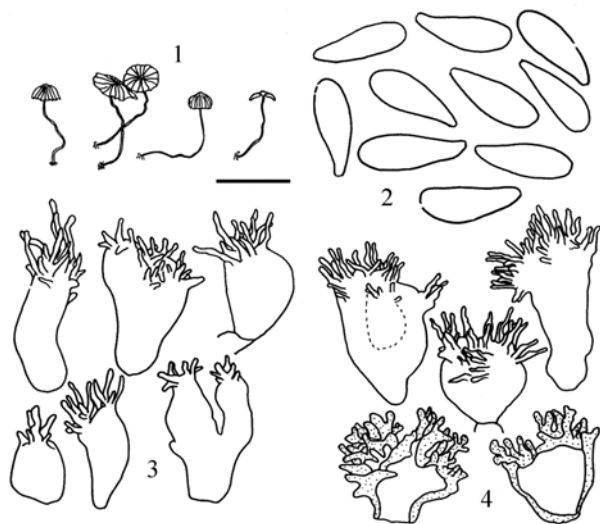


Fig. 50. *Marasmius cremeus* (N. Wannathes 118). 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pileipellis, Scale bar 1 = 20 mm, 2-4 = 10 μ m

discoloring pale grayish orange in splotches. *Context* thin, white. *Lamellae* adnate, subdistant (8-15) with 0-1 series of lamellulae, non-intervenose, narrow to moderately broad (0.5-1.0 mm), light buff to cream-colored, non-marginate. *Stipe* 11-30 \times 0.2-0.5 mm, central, cylindrical, terete, filiform, tough, pliant, glabrous, non-insititious, base with short, tufted, white to cream (4A3) basal tomentum; yellowish white to dark brownish orange (7C5-7) at the apex, dark brown (7-8F4-6) to nearly black at the base; rhizomorphs absent. *Odor* and *taste* not distinctive.

Basidiospores (11-)12-14(-16) \times 3-4(-5) μ m [x_{mr} = 11.7-13.5 \times 3.1-4.6 μ m, x_{mm} = 12.7 \pm 0.6 \times 3.8 \pm 0.5 μ m, Q = 1.8-5.0, Q_{mr} = 2.7-4.0, Q_{mm} = 3.4 \pm 0.5, n = 25 spores, s = 8 specimens], narrowly ellipsoid to fusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 20-26 \times 5-7 μ m, clavate to cylindrical, 4-spored. *Basidioles* clavate to subfusoid. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 9-19 \times 6-12 μ m, cylindrical to pyriform, clavate, broadly clavate or irregular in outline, hyaline, thin-walled; apical setulae 2-8(-11) \times 0.5-1.0 μ m, crowded, narrowly

cylindrical to cylindrical or irregular in outline, rarely fork, subacute to acute, hyaline to pale yellow, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled to mottled, composed of *Siccus*-type broom cells; main body (8-)12-21 \times 7-16 μ m, clavate to broadly clavate, cylindrical, subglobose, pyriform or turbinate, sometimes irregular in outline, hyaline, inamyloid, thin- to thick-walled; apical setulae (2-)3-6(-11) \times 0.5-1(-1.5) μ m, narrowly cylindrical to conical or irregular in outline, often wavy, conical to subacute, hyaline to pale yellow, inamyloid, thick-walled. *Pileus trama* interwoven, *lamellar trama* regular to interwoven; hyphae 3-8(-11) μ m diam, cylindrical to inflated, smooth, hyaline, weakly dextrinoid to dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 2-5(-7) μ m diam, parallel, cylindrical, smooth, yellowish brown to brown, dextrinoid, thin- to thick-walled (> 1 μ m), non-gelatinous. *Stipe trama* hyphae (2.5-)4-8(-10) μ m diam, parallel, cylindrical, smooth, hyaline, inamyloid to weak dextrinoid, thin-walled. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat, and known distribution: Scattered to gregarious, seldom solitary, on undetermined dicotyledonous leaves. Northern Thailand.

Material examined. Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mok Fa waterfall, on Hwy 1095, N19° 6.581', E98° 46.353', 1014 meters, 1 Aug. 2003, N. Wannathes 069 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, "Water Conservation Area" Highway 1,095 at 22 km marker, N. 19° 7.5' E 98° 45.7' alt. 724 m., 4 August 2003, N. Wannathes 085 (CMU); same location, 13 June 2004, N. Wannathes 171 (CMU); Chiang Mai Province, Doi Suthep-Pui National Park, Montathan Falls trail, 650 meters, 4 Jul. 2002, D.E. Desjardin 7455 (CMU, SFSU); same location, 6 Jul. 2004, Y. S. Tan 320 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Sangasabhasri Land on the way to Huai Kok Ma Village, N 18° 48.4' E 98° 54.6' alt. 1,146 m., 2 July 2005, N. Wannathes 383 (CMU, SFSU); Chiang Mai Province, Doi Inthanon National Park, at 25 km marker on Highway 1009, N18° 32.54', E98° 33.51', 1076 meters, 10 Jun. 2004, N. Wannathes154 (CMU, SFSU), same location, 27 June 2005, N. Wannathes 366 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Pa Deng Village, Pathummikaram temple, on Hwy 1095, N19° 06' 28.8", E98° 44' 47.3", 1050 meters, 22 Aug. 2003, N. Wannathes 118 (CMU: **holotype**; SFSU: **isotype**); same location, 7 Aug. 2003, N. Wannathes 093 (CMU, SFSU); Chiang Mai Province, Mushroom Research Centre, 27 km marker on Hwy 1095, 27 Jul.

2003, N. Wannathes 042(CMU, SFSU); same location, 10 Aug. 2003, N. Wannathes 099 (CMU, SFSU).

Discussion: *Marasmius cremeus* is distinguished by the following features: a relatively small (3–14 mm diam), sulcate, cream-colored pileus; subdistant (8–15), narrow, cream-colored, non-collariate, non-marginate lamellae; a filiform (0.2–0.5 mm diam), glabrous, non-insititious, dark brown stipe with white to cream-colored basal tomentum; clavate spores with mean range $11.7\text{--}13.5 \times 3.1\text{--}4.6 \mu\text{m}$; no pleurocystidia and no caulocystidia; *Siccus*-type cheilocystidia and pileipellis cells with pale yellow setulae; and growth on dicotyledonous leaves. The new Thai species is most closely allied *M. similis* Berk. & M.A. Curtis, a species described from South Carolina, USA in 1849 and one that is known only from the type specimen (K!; isotype FH!). *Marasmius similis* is nearly indistinguishable from *M. cremeus*, differing only in forming a white pileus (not cream-colored) and in growing on twigs. A study of the type specimen of *M. similis* shows no differences in micromorphology when compared to the Thai specimens. However, because *M. similis* is known from only a single specimen collected on twigs in a temperate forest in eastern North America, until more material from that region is discovered and compared with the Thai material, we choose to recognize the Asian organism as a distinct species. We conclude that *M. cremeus* is what van Overeem and van Overeem-de Haas (1922) reported as *M. similis* from Java (cf. Desjardin *et al.* 2000:190).

Marasmius cremeus is also phenetically similar to *M. bellus* Berk., a cream-colored to yellow species from the neotropics, and to *M. haediniformis* Singer, a pure white species from Africa and Ecuador. The latter two species differ from *M. cremeus* in forming larger pilei (13–37 mm diam), thicker stipes (1.0–1.5 mm), and slightly smaller basidiospores on average, ca $11.3 \times 3.3 \mu\text{m}$ (Singer 1976; Pegler 1977, 1983).

A bipolar mating system was reported for *M. cremeus* by Wannathes *et al.* (2007).

43. *Marasmius hypochroides* Berk. & Broome, J. Linn. Soc., Bot. 14: 35. 1873.

(Figs 51, 57-2)

Pileus 17-56 mm diam., convex to plano-convex or applanate, often subumbonate, rugulose, striate to sulcate, glabrous to subvelutinous, dull, disc brown (7E8) to dark brown (7F7-8), margin brownish orange (5C5) to yellowish brown (5E6). *Context* yellowish white to cream, thin. *Lamellae* free to adnexed, distant (12-16) with 3-4 series of lamellulae, broad (2-10 mm), often intervenose, cream (4B2) with brownish orange edges. *Stipe* 38-95 \times 1-3 mm, central, cylindrical, wiry, hollow, glabrous, non-insititious, apex buff, base yellowish brown (5D8) to reddish brown (8E7). *Odor* and *taste* not distinctive.

Basidiospores (8-)9-12(-13) \times 5-6(-8) μm [$x_{mr} = 8.9\text{--}10.8 \times 5.1\text{--}6.2 \mu\text{m}$, $x_{mm} = 9.9 \pm 0.7 \times 5.6 \pm 0.4 \mu\text{m}$, $Q_{mr} = 1.6\text{--}2.0$, $Q_{mm} = 1.8 \pm 0.1$, $n = 25$ spores, $s = 6$ specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* cylindrical to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body (8-)10-25 \times 4-10 μm , cylindrical to clavate or pyriform, hyaline, inamyloid, thin-walled; apical setulae 4-23(-32) \times 1-1.5 μm , cylindrical, inamyloid, subacute, brown to light brown, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 8-19(-26) \times 5-11 μm , clavate to broadly clavate or pyriform, often branched, hyaline, inamyloid, thin- to thick walled; apical setulae 3-11(-18) \times 1-2 μm , crowded, cylindrical, subacute to acute, brown to dark brown, thick-walled. *Pileus trama* interwoven, dextrinoid to weakly dextrinoid. regular to interwoven, cylindrical, smooth, hyaline, weakly dextrinoid to dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-6 μm diam., subparallel, cylindrical, light brown to brown, smooth, dextrinoid, thin- to thick-walled, non-gelatinous. *Stipe trama* hyphae 7-12(-18) μm diam., subparallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to solitary on dicotyledonous leaves or on wood. Java, Malaysia, Northern Thailand and Sri Lanka.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa

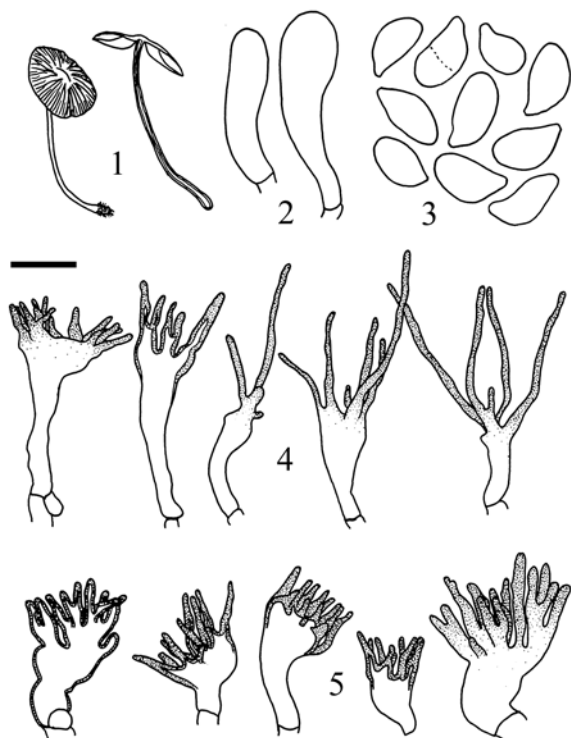


Fig. 51. *Marasmius hypochooides* (N. Wannathes 136). 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5. Pileipellis, Scale bar 1 = 20 mm, 2-5 = 10 μ m

Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 28 August 2003, N. Wannathes 136 (CMU, SFSU); same location, 14 June 2004, N. Wannathes 160 (CMU, SFSU); same location, 25 June 2005, N. Wannathes 335 (CMU, SFSU); Chiang Mai Province, Mae Taeng District, Tung Joaw Village, N 19° 8.07' E 98° 38.9' alt. 1423 m., 30 June 2004, N. Wannathes 190 (CMU, SFSU); Chiang Mai Province, Mushroom Research Centre, 27 km marker on Hwy 1095, 28 July 2004, N. Wannathes 247 (CMU); Chiang Mai Province, Mae Taeng District, Sri Lanna National Park, near Mae Ngad Dam, 9 August 2005, N. Wannathes 405 (CMU, SFSU).

Discussion: *Marasmius hypochooides* is characterized by a relatively large, rugulose, striate to sulcate pileus colored brownish orange to yellowish brown with dark brown disc, distant (12-16), broad (2-10 mm) lamellae, moderately broad basidiospores with mean $9.9 \times 5.6 \mu\text{m}$, and mean $Q = 1.8$, cheilocystidia with very long setulae (4-32 μm), and an absence of pleurocystidia and caulocystidia. The Thai specimens match nicely those from Java reported by Desjardin *et al.* (2000). For a comparison with similar species, refer to Desjardin *et al.* (2000).

44. *Marasmius makok* Wannathes, Desjardin & Lumyong, **sp. nov.** (Figs 52, 57-3)

Mycobank: MB512423

Etymology: 'makok' (Thai) = olive; referring to the olive colour of the pileus margin.

Pileus 3-8 mm diametro, conicus, striatus, pruinosis, hebetatus, disco cinereo-atrobrunneo, margine olivacea. **Contextus** olivaceo-cinereus, tenuis. **Lamellae** liberae, distantes (12), latae (1-2 mm), pallide cinereo-albae, haud marginatae, haud intervenosae. **Stipes** 28-45 \times 0.3-0.5 mm, centralis, cylindricus, filo metallico similis, glaber, haud insititius, apice flavo-albo, basi atrorubinea. **Odor saporque** non propria. **Basidiosporae** (14-)15-17 \times 3-4 μm , anguste fusoidae usque clavatae, oblique curvae, laeves, hyalinae, inamyloideae, tenuitunicatae **Basidia** non observata. **Basidiolae** fusoidae. **Cheilocystidia** vulgaria, typi *Sicci*; 13-22 \times 7-9 μm , cylindrata usque clavata vel adumbratim inaequabilia, hyalina, inamyloidea, tenuitunicata; setulis apicalibus 2-4 \times 1 μm , cylindricis usque conicis, subacutis, hyalinis, tenuitunicatis. **Pleurocystidia** nulla. **Pileipellis** hymeniformis, haud maculosus, typi *Sicci*; 13-22 \times 6-9 μm , cylindricus usque clavatus vel adumbratim inaequabilis, hyalinus, inamyloideus, tenui- usque crassetunicatus; setulis apicalibus 2-5 \times 1 μm , coartatis, cylindricis, subacutis, brunneis, crassetunicatis. **Trama pilei** intertexta, dextrinoidea. **Trama lamellae** intertexta, hyphis 3-8 μm diametro, cylindricis, laevibus, hyalinis, dextrinoideis, tenuitunicatis, haud gelatinosis. **Stipitipellis** subparallelus, hyphis 3-4 μm diametro, cylindricis, brunneis, laevibus, inamyloideis, crassetunicatis (usque ad 1.5 μm), haud gelatinosis. **Trama stipitis** parallela, hyphis 3-7 μm diametro, cylindricis, hyalinis, laevibus, dextrinoideis, tenuitunicatis, haud gelatinosis. **Caulocystidia** nulla. **Fibulae** praesentes in omnibus texturis.

Typus: Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., dispersus usque gregarius in folis plantae dicotyledoneae, 3 July 2004, N. Wannathes 201 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 3-8 mm diam., conical, striate, pruinose, dull, disc dark grayish brown (5F3), margin olive (3E-F3-5). **Context** olive grey, thin. **Lamellae** free, distant (12), broad (1-2 mm), pale greyish white, non-marginate, non-intervenose. **Stipe** 28-45 \times 0.3-0.5 mm, central, cylindrical, wiry, glabrous, non-insititious, apex yellowish white, base dark ruby (12F4). **Odor** and **taste** not distinctive.

Basidiospores (14-)15-17 \times 3-4 μm [$x = 15.8 \pm 0.9 \times 3.4 \pm 0.4 \mu\text{m}$, $Q = 3.8-5.7$, $Q_m = 4.7$, $n = 25$ spores, $s = 1$ specimen], narrowly fusoid to clavate, curved in profile, smooth, hyaline, inamyloid, thin-walled. **Basidia** not observed. **Basidioles** fusoid. **Cheilocystidia** common, of *Siccus*-type broom cells; main body 13-22 \times 7-9 μm , cylindrical to clavate or

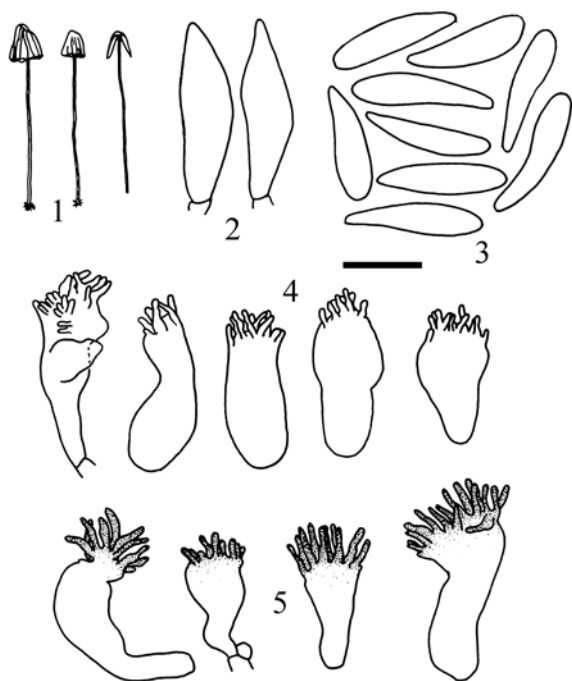


Fig. 52. *Marasmius makok* (N. Wannathes 201). 1. Basidiomes 2. Basidiolae 3. Basidiospores 4. Cheilocystidia 5. Pileipellis, Scale bar 1 = 20 mm, 2-5 = 10 μ m

irregular in outline, hyaline, inamyloid, thin-walled; apical setulae $2-4 \times 1 \mu\text{m}$, cylindrical to conical, subacute, hyaline, thin-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, not mottled, composed of *Siccus*-type broom cells; main body $13-22 \times 6-9 \mu\text{m}$, cylindrical to clavate or irregular in outline, hyaline, inamyloid, thin- to thick-walled; apical setulae $2-5 \times 1 \mu\text{m}$, crowded, cylindrical, subacute, brown, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae $3-8 \mu\text{m}$ diam., interwoven, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae $3-4 \mu\text{m}$ diam., subparallel, cylindrical, brown, smooth, inamyloid, thick-walled (up to $1.5 \mu\text{m}$), non-gelatinous. *Stipe trama* hyphae $3-7 \mu\text{m}$ diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Inthanon National Park Junction of Highway 1,009 and road to Mae Chaem, N $18^\circ 31.6'$ E $98^\circ 29.6'$ alt. 1,703 m., 3 July 2004, N. Wannathes 201 (CMU: **holotype**; SFSU: **isotype**)

Discussion: *Marasmius makok* is distinguished by a conical, primarily olive pigmented pileus with dark grayish brown disc, distant, broad, pale greyish white lamellae, a dark ruby red stipe, clavate basidiospores with mean $15.8 \times 3.4 \mu\text{m}$, and an absence of pleurocystidia and caulocystidia. The Thai new species is phenetically similar to two olive-coloured neotropical species. *Marasmius digilii* Singer, described from Argentina, differs in forming a larger, convex pileus, subclose to subdistant lamellae, and smaller basidiospores in the range $6-9 \times 3.5-4.5 \mu\text{m}$ (Singer, 1976). *Marasmius trinitatis* Dennis, common throughout the neotropics and reported from Papua New Guinea by Desjardin and Horak (1997), differs in forming a campanulate-convex pileus, more lamellae (16-20), a brown to fulvous stipe (not ruby red), grows on woody debris, and has smaller basidiospores in the range $8.3-12.5 \times 2.7-4 \mu\text{m}$ (Singer, 1976). *Marasmius makok* is sister to *M. bambusiniformis* Singer (No. 48 below) in the ITS phylogenetic tree, and the latter species differs only in pileus shape and color (campanulate-convex with reddish brown and brownish orange tones), and a brown stipe.

45. *Marasmius cupreostipes* Wannathes, Desjardin & Lumyong, **sp. nov.** (Fig. 53)
Mycobank: MB512424

Etymology: 'cupreo' = copper, 'stipes' = stipe; referring to the copper coloured stipe of dried basidiomes.

Pileus 3-17 mm diametro, campanulatus, sulcatus usque plicatus, glaber, hebetatus, disco aurantiaco-brunneo, margine laete aurantiaco-brunneo. *Contextus* creameus, tenuis. *Lamellae* annexae, distantes (10-12) sine lamellula, latae (1-2 mm), creameae, haud marginatae, haud intervenosae. *Stipes* 67-250 \times 0.5-0.8 mm, centralis, cylindratus, filo metallico similis, glaber, insititius usque haud insititius, apice aurantiaco, basi cuprea, ubique cuprea in sicco. *Odor saporque* non propria. *Basidiosporae* (17-)18-21(-26) \times 4-5(7-) μm , cylindratae usque fusoideae, oblique curvae, laeves, hyalinae, inamyloideae, tenuitunicatae *Basidia* non observata. *Basidiolae* fusoideae usque clavatae. *Cheilocystidia* vulgaris, typi *Sicci*; $13-20 \times 6-11 \mu\text{m}$, cylindrata usque clavata vel adumbratim inaequabilia, plerumque ramosa, hyalina, inamyloidea, tenuitunicata; setulis apicalibus $2-6 \times 1 \mu\text{m}$, cylindratis usque conicis, plerumque undulatis, subacutis, pallide flavis, tenui-usque crassetunicatis. *Pleurocystidia* nulla. *Pileipellis* hymeniformis, haud maculosus, typi *Sicci*; $10-18(-30) \times 6-15 \mu\text{m}$, clavatus usque pyriformis vel adumbratim

inaequabilis, saepe ramosus, hyalinus usque pallide flavus, inamyloideus, tenuitunicatus; setulis apicalibus $2-4 \times 1-1.5 \mu\text{m}$, coartatis, cylindratis, subacutis, brunneis usque flavo-brunneis, tenui- usque crassetunicatis. *Trama pilei* intertexta, dextrinoidea usque leniter dextrinoidea. *Trama lamellae* intertexta, hyphis 5-8(-12) μm diametro, cylindratis usque inflatis, laevis, hyalinis, dextrinoidea usque leniter dextrinoidea, tenuitunicatis, haud gelatinosis. *Stipitipellis* subparallelus, hyphis 3-5 μm diametro, cylindratis, brunneis, laevis, inamyloideis, tenuitunicatis, haud gelatinosis. *Trama stipitis* parallela, hyphis 6-10 μm diametro, cylindratis, hyalinis, laevis, dextrinoideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* nulla. *Fibulae* praesentes in omnibus texturis.

Typus: Chiang Mai Province, Mushroom Research Centre, 27 km marker on Hwy 1095, dispersus usque gregarius in folis plantae dicotyledoneae, 3 June 2004, N. Wannathes 150 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 3-17 mm diam., campanulate, sulcate to plicate, glabrous, dull, disc orangish brown, margin light orangish brown. *Context* cream, thin. *Lamellae* adnexed, distant (10-12) with no lamellula, broad (1-2 mm), cream, non-marginate, non-intervenose. *Stipe* 67-250 \times 0.5-0.8 mm, central, cylindrical, wiry, glabrous, insititious to non-insititious, apex orange, base copper-colored, copper-colored overall when dried. *Odor* and *taste* not distinctive.

Basidiospores (17-)-18-21(-26) \times 4-5(7-) μm [$x = 19.4 \pm 1.9 \times 5.0 \pm 0.6 \mu\text{m}$, $Q = 2.6-5.8$, $Q_m = 4.0$, $n = 25$ spores, $s = 1$ specimen], cylindrical to fusoid, curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 13-20 \times 6-11 μm , cylindrical to clavate or irregular in outline, usually branched, hyaline, inamyloid, thin-walled; apical setulae 2-6 \times 1 μm , cylindrical to conical, usually wavy, subacute, pale yellow, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, not mottled, composed of *Siccus*-type broom cells; main body 10-18(-30) \times 6-15 μm , clavate to pyriform or irregular in outline, often branched, hyaline to pale yellow, inamyloid, thin-walled; apical setulae 2-4 \times 1-1.5 μm , crowded, cylindrical, subacute, brown to yellowish brown, thin- to thick-walled. *Pileus trama* interwoven, dextrinoid to weakly dextrinoid. *Lamellar trama* hyphae 5-8(-12) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, dextrinoid to weakly dextrinoid, thin-walled, non-gelatinous.

Stipitipellis hyphae 3-5 μm diam., subparallel, cylindrical, brown, smooth, inamyloid, thin-walled, non-gelatinous. *Stipe trama* hyphae 6-10 μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.



Fig. 53. *Marasmius cupreostipes* (N. Wannathes 150). 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pileipellis, Scale bar 1 = 20 mm, 2-4 = 10 μm

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Mushroom Research Centre, 27 km marker on Hwy 1095, 3 June 2004, N. Wannathes 150 (CMU: **holotype**; SFSU: **isotype**).

Discussion: This new species is characterized by a campanulate, plicate, orangish brown pileus, distant, cream-coloured lamellae, clavate basidiospores with mean $19.4 \times 5.0 \mu\text{m}$, and an absence of pleurocystidia and caulocystidia. The most distinctive feature is its very long (up to 250 mm) copper-colored stipe. *Marasmius aciebrunneus* Corner, described from Singapore, differs in forming brown-marginate lamellae, a fuscous brown stipe only 20-30 mm long, and longer but narrower basidiospores with mean $24.8 \times 4.3 \mu\text{m}$ (Holotype E!; Corner 1996). *Marasmius selangorensis* Y.S. Tan & Desjardin, described

recently from Malaysia, differs in forming a more brown to yellowish brown pileus, more numerous lamellae (12-18), a stipe only up to 43 mm long coloured brownish orange to dark brown (brown when dried), and acerose apical setulae on broom cells that are 4-15 μm long (Tan *et al.*, 2007). *Marasmius longistipitatus* Antonín, described from Africa, differs in forming paler pilei (pale greyish orange to orange white), and distinctive pleurocystidia. In all other characters the two species are similar (Antonín, 2004, 2007).

46. *Marasmius corneri* Wannathes, Desjardin & Lumyong, Mycol. Res. 111: 992. 2007.

(Figs 54)

\equiv *Marasmius incarnatus* Corner, Beih. Nova Hedwigia 111: 60. 1996., nom. illegit., non *Marasmius incarnatus* Quél., Enchir. Fung.:142. 1886.

Pileus 10-43 mm diam, obtusely conical to convex or broadly convex, with a shallow broad umbo, disc occasionally rugulose, margin striate to sulcate, dull, dry, minutely velutinous, disc brownish orange (7C8) to light brown (7D8), orange (6B8) or brownish yellow (5C7-8), margin light orange (5A4), brownish orange (6C7), orange (5A6) or grayish orange (5B5-6). *Context* thin, yellowish white. *Lamellae* adnexed to subfree, subdistant (12-18) with 1-4 series of lamellulae, non-intervenose, narrow, yellowish white (4A2-3), non-marginate. *Stipe* 23-90 \times 0.8-3 mm, central, terete, cylindrical, with or without a subbulbous base, hollow, glabrous, non-insititious, base covered with brownish orange mycelium, apex yellowish white (3-4A2) to light orange (5A4), base brownish orange (6C8) to dark brown (6F8) or dark reddish brown, rhizomorphs absent. *Odor* and *taste* not distinctive.

Basidiospores (16-)18-20(-22) \times 4-5 μm [$x_{\text{mr}} = 18.3-19.6 \times 4.3-4.7 \mu\text{m}$, $x_{\text{mm}} = 19.0 \pm 0.6 \times 4.5 \pm 0.2 \mu\text{m}$, $Q = 3.2-5.5$, $Q_{\text{mr}} = 4.0-4.5$, $Q_{\text{mm}} = 4.2 \pm 0.2$, $n = 25$ spores, $s = 4$ specimens], cylindrical to fusoid, often curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* clavate to cylindrical. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 15-25 \times 4-9 μm , cylindrical to clavate, broadly clavate or

irregular in outline, hyaline, thin-walled; apical setulae (2-)3-10 \times 0.5-1.5(-2) μm , narrowly conical to cylindrical or irregular in outline, subacute to acute, pale yellow, inamyloid, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, not mottled, composed of *Siccus*-type broom cells; main body (7-)14-25(-30) \times 5-7(-10) μm , clavate to broadly clavate, cylindrical, pyriform or sometimes irregular in outline, hyaline, inamyloid, thin- to thick-walled; apical setulae (2-)3-10 \times 0.8-1.5 μm , cylindrical to conical or irregular in outline, subacute to acute, pale yellow to tawny, inamyloid, thick-walled. *Pileus trama* and *lamellar trama* interwoven; hyphae (2-)4-8(-11) μm diam, cylindrical, smooth, hyaline, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 5-6(-10) μm diam, parallel, cylindrical, smooth, hyaline to yellowish brown, dextrinoid to strong dextrinoid, thin- to thick-walled ($>1.5 \mu\text{m}$), non-gelatinous. *Stipe trama* hyphae 3-7(-12) μm diam, parallel, cylindrical, smooth, hyaline, dextrinoid to strongly dextrinoid, thin- to thick-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

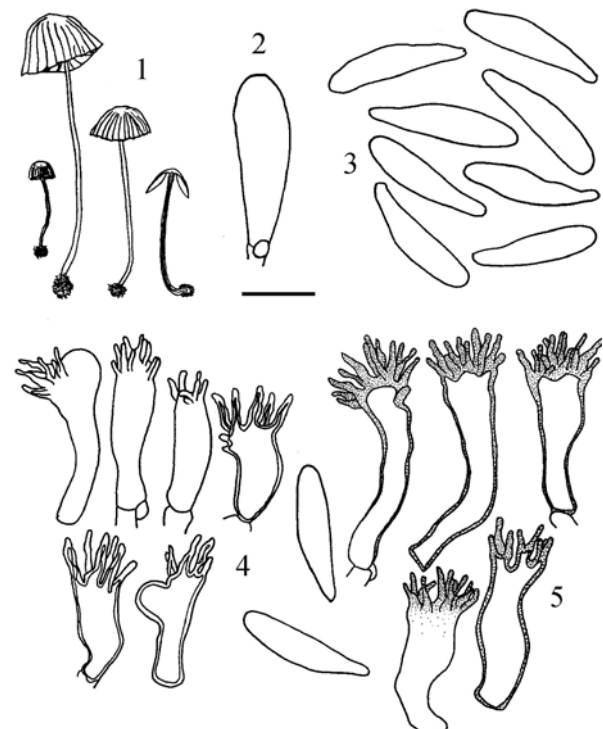


Fig. 54 *Marasmius corneri* (N. Wannathes 066). 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5. Pileipellis, Scale bar 1 = 20 mm, 2-5 = 10 μm

Habit, habitat, and known distribution: Scattered to gregarious on undetermined dicotyledonous leaves or wood, Singapore and Northern Thailand.

Material examined: Singapore. Gardens Jungle, 8 Aug. 1940, Corner s.n. (E: **holotype**). Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mok Fa waterfall on Hwy 1095, N19° 6.581', E98° 46.353', 1014 meters, 25 Jul. 2003, N. Wannathes 026 (CMU, SFSU); same location, 1 Aug. 2003, N. Wannathes 066 (CMU, SFSU); same location, 13 Aug. 2003, N. Wannathes 103 (CMU, SFSU); same location, 29 June 2004, Y.S. Tan 274 (CMU, SFSU); same location, 7 Jul. 2004, Y.S. Tan 325 and N. Wannathes 218 (CMU, SFSU); same location, 21 Aug. 2004, N. Wannathes 269 (CMU, SFSU).

Discussion: The name used by Corner (1996) for this new species described recently from Singapore is a homonym (non Quélet 1886) and a new name was proposed by Wannathes et al. (2007). Their choice of epithet honors E.J.H. Corner who has published many new species of *Marasmius* from Malaysia. The material from northern Thailand differs only slightly from the protologue in having pilei that are more deeply pigmented, ranging from greyish orange to brownish yellow. The micromorphological characters are indistinguishable from those of the holotype specimen (E!).

A bipolar mating system was reported for *M. corneri* by Wannathes et al. (2007) based on Thai material.

47. *Marasmius imitarius* Wannathes, Desjardin & Lumyong, **sp. nov.** (Figs 55, 57-4)
MycoBank: MB 512425

Etymology: 'imitari' = to imitate; referring to the micromorphology of the species being indistinguishable from that of a number of other species.

Pileus 2-15 mm diametro, obtuse conicus usque convexus ubi iuvenis, expansus et plano-convexus et saepe leviter depressus ubi vetus, umbone rugoso, striatus usque sulcatus, pruinosis, hebetatus, disco brunneo usque rubro-brunneo, margine pallidiore usque laete brunnea. **Contextus** flavo-albus, tenuis. **Lamellae** annexae, distantes (10-12), angustae, cremaeae, brunneomarginatae, haud intervenosae. **Stipes** 8-23(-80) × < 0.5 mm, centralis, cylindratus, filo metallico similis, glaber, insititius usque haud insititius, apice albido, basi brunnea usque atrobrunnea. **Odor saporque** non propria. **Basidiosporae** 17-20(-21) × 4-5 µm, cylindratae usque fusoidae, oblique curvae, laeves, hyalinae, inamyloideae, tenuitunicatae **Basidia** non observata. **Basidiolae** cylindratae usque clavatae. **Cheilocystidia** vulgaria, typi *Sicci*; 8-17(-23) × (3-)-6-10(-15) µm, cylindrata usque clavata vel pyriformia, hyalina,

inamyloidea, tenuitunicata; setulis apicalibus 3-9 × 1 µm, cylindratis, plerumque undulatis, saepe furcatis, inamyloideis, subacutis, hyalinis usque pallide flavis, crassetunicatis. *Pleurocystidia* nulla. *Pileipellis* hymeniformis, leniter maculosus, typi *Sicci*; 10-18 × 7-9(-12) µm, clavatus usque late clavatus vel pyriformis, hyalinus, inamyloideus, tenui- usque crassetunicatus; setulis apicalibus 3-5(-8) × 1-1.5 µm, coartatis, cylindratis, plerumque undulatis, subacutis, brunneis usque atrobrunneis, crassetunicatis. *Trama pilei* intertexta, leniter dextrinoidea usque inamyloidea. *Trama lamellae* intertexta, hyphis 3-6(-8) µm diametro, cylindratis usque inflatis, laevis, hyalinis, leniter dextrinoidea usque inamyloidea, tenuitunicatis, haud gelatinosis. *Stipitipellis* subparallelus, hyphis (2-)-3-5(-6) µm diametro, cylindratis, brunneis usque atrobrunneis, laevis, inamyloideis usque leniter dextrinoideis, crassetunicatis, haud gelatinosis. *Trama stipitis* subparallela, hyphis 3-5(-8) µm diametro, cylindratis, hyalinis, laevis, inamyloideis usque leniter dextrinoideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* nulla. *Fibulae* praesentes in omnibus texturis.

Typus: Phrae Province, Muang District, Pa Dang, Nong Kam Village, near Nong Kam reservoir, dispersus usque gregarius in folis plantae dicotyledoneae vel ligno, 18 August 2005, N. Wannathes 423 (CMU: **holotypus**; SFSU: **isotypus**).

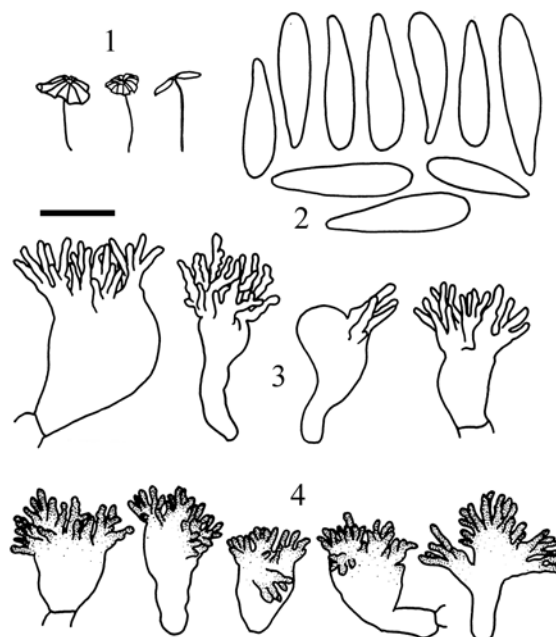


Fig. 55. *Marasmius imitarius* (N. Wannathes 423). 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pileipellis, Scale bar 1 = 20 mm, 2-4 = 10 µm

Pileus 2-15 mm diam., obtusely conical to convex when young, expanding to convex and often slightly depressed in age, with a rugulose umbo, striate to sulcate, pruinose, dull, disc brown (6-7E5-8) to reddish brown (8E6-7), margin paler to light brown (7D5-6). **Context** yellowish white, thin. **Lamellae** adnexed,

distant (10-12), narrow, cream with brown edges, non-intervenose. *Stipe* 8-23(-80) × < 0.5 mm, central, cylindrical, wiry, glabrous, insititious to non-insititious, apex off-white, base brown to dark brown. *Odor* and *taste* not distinctive.

Basidiospores 17-20(-21) × 4-5 μm [$x_{mr} = 17.8-19.2 \times 4.1-4.7 \mu\text{m}$, $x_{mm} = 18.6 \pm 0.7 \times 4.4 \pm 0.3 \mu\text{m}$, $Q_{mr} = 4.1-4.4$, $Q_{mm} = 4.4 \pm 0.3$, $n = 25$ spores, $s = 3$ specimens], cylindrical to fusoid, curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* cylindrical to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 8-17(-23) × (3-)6-10(-15) μm, cylindrical to clavate or pyriform, hyaline, inamyloid, thin-walled; apical setulae 3-9 × 1 μm, cylindrical, usually wavy, often forked, inamyloid, subacute, hyaline to pale yellow, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled, composed of *Siccus*-type broom cells; main body 10-18 × 7-9(-12) μm, clavate to broadly clavate or pyriform, hyaline, inamyloid, thin- to thick-walled; apical setulae 3-5(-8) × 1-1.5 μm, crowded, cylindrical, usually wavy, subacute, brown to dark brown, thick-walled. *Pileus trama* interwoven, weakly dextrinoid to inamyloid. *Lamellar trama* hyphae 3-6(-8) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, weakly dextrinoid to inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae (2-)3-5(-6) μm diam, subparallel, cylindrical, brown to dark brown, smooth, inamyloid to weakly dextrinoid, thick-walled, non-gelatinous. *Stipe trama* hyphae 3-5(-8) μm diam., subparallel, cylindrical, hyaline, smooth, inamyloid to weakly dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves or on wood, Northern Thailand.

Material examined: Thailand. Chiang Rai Province, Muang District, Khun Con Waterfall, 12 June 2005, N. Wannathes 297 (CMU, SFSU); Phrae Province, Muang District, Pa Dang, Nong Kam Village, near Nong Kam reservoir, 18 August 2005, N. Wannathes 423 (CMU: **holotype**; SFSU: **isotype**) and N. Wannathes 425 (CMU, SFSU).

Discussion: *Marasmius imitarius* is characterized by a light brown, sulcate pileus

with darker brown to reddish brown disc, distant (10-12), cream-coloured lamellae with brown edges, clavate basidiospores with mean $18.6 \times 4.4 \mu\text{m}$, an absence of pleurocystidia and caulocystidia, and growth mostly on woody sticks. The micromorphology of this new species is very similar to that of many other species, hence our choice of epithets. *Marasmius kanchingensis* Y.S. Tan & Desjardin, described recently from Malaysia, differs in forming a striped pileus with more brownish orange to greyish orange tones, more lamellae (14-16), slightly longer basidiospores with mean range 18.5-20.5 μm long, and growth on leaves. *Marasmius mazatecus* Singer, an orange-ferruginous to deep rusty-red species from Mexico, *M. striaepileus* Antonin, an orangish brown species from Burundi, and *M. sierraleonis* Beeli, a dull yellowish to rusty brown species from Africa, differ primarily in forming larger, more brightly pigmented pilei. *Marasmius bambusiniiformis* Singer (see below) differs in forming a brownish orange to greyish orange pileus, more lamellae (10-18), has slightly smaller basidiospores with mean $16.2 \times 3.7 \mu\text{m}$, and grows on dicot leaves. In the ITS phylogenetic analyses, *M. imitarius* is not sister to *M. bambusiniiformis*.

48. *Marasmius bambusiniiformis* Singer, Fl. Neotrop. Monogr. 17: 167. 1976.

(Figs 56, 57-5)

Pileus 3-10 mm diam., obtusely conical, usually umbonate, striate to sulcate, pruinose, dull, disc reddish brown (9E8) to brownish orange (6C8), margin brown (7D8) to greyish orange (6B4). *Context* thin, cream. *Lamellae* adnexed, subdistant (10-18) with 0-1 series of lamellulae, narrow, cream with brown edges, non-intervenose. *Stipe* 13-52 × 0.2-0.4 mm, central, cylindrical, wiry, glabrous, non-insititious, apex yellowish white, base brown. *Odor* and *taste* not distinctive.

Basidiospores (15-)16-18(-19) × 3.5-4 μm [$x_{mr} = 15.7-17 \times 3.6-4.0 \mu\text{m}$, $x_{mm} = 16.2 \pm 0.7 \times 3.7 \pm 0.2 \mu\text{m}$, $Q_{mr} = 4.3-4.5$, $Q_{mm} = 4.4 \pm 0.1$, $n = 25$ spores, $s = 3$ specimens], narrowly fusoid, curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body (4-)10-18 × 6-9 μm, cylindrical to clavate,

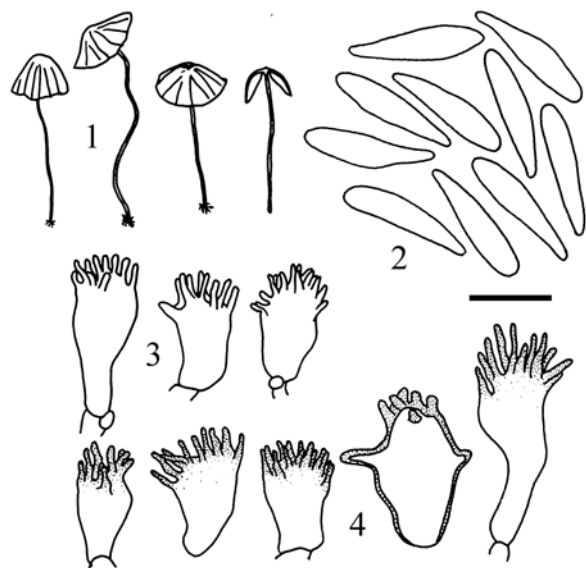


Fig. 56. *Marasmius bambusiniformis* (N. Wannathes 410). 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pileipellis, Scale bar 1 = 20 mm, 2-4 = 10 μ m

hyaline, inamyloid, thin-walled; apical setulae $2-5 \times 1 \mu\text{m}$, cylindrical to conical, subacute, yellow, thick-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, weakly mottled, composed of *Siccus*-type broom cells; main body $10-20 \times (4-7)-13 \mu\text{m}$, cylindrical to clavate or irregular in outline, seldom branched, hyaline, inamyloid, thin- to thick-walled; apical setulae $2-5(7) \times 1 \mu\text{m}$, crowded, cylindrical, subacute, brownish yellow to light brown, thick walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae $(3-4)-10(-15) \mu\text{m}$ diam., interwoven, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae $(2-4)-7 \mu\text{m}$ diam., subparallel, cylindrical, yellowish brown to light brown, smooth, dextrinoid, thick-walled (up to $1.5 \mu\text{m}$), non-gelatinous. *Stipe trama* hyphae $3-10 \mu\text{m}$ diam, parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, Malaysia, neotropics, Northern Thailand and Papua New Guinea.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 25 June 2005, N. Wannathes 329 (CMU, SFSU); Chiang Mai Province, Doi Inthanon National Park, At 25 km marker on Highway 1,009, N 18° 32.5' E 98° 33.5' alt. 1,076 m., 27 June 2005, N. Wannathes 368 (CMU, SFSU); Phrae Province, Muang District, Suen Keun, Na

Koo Haa Waterfall, 15 August 2005, N. Wannathes 410 (CMU, SFSU).

Discussion: Diagnostic features of *M. bambusiniformis*, include: a small, striate to sulcate pileus with reddish brown to brownish orange disc and greyish orange margin; subdistant (10-18), cream-coloured lamellae with brown edges; a wiry, glabrous, non-insititious stipe; basidiospores with mean $16.2 \times 3.7 \mu\text{m}$; an absence of pleurocystidia and caulocystidia; and growth on dicot leaves. The Thai specimens match nicely those reported from Papua New Guinea by Desjardin and E. Horak (1997), but differ from the holotype collected in Ecuador in forming more lamellae (10-18 vs 7-10).

Section *Sicci*, subsect. *Siccini*, ser. *Haematocephali* Singer, Fl. Neotrop. Monogr. 17: 201. 1976.

Type: *Marasmius haematocephalus* (Mont.) Fr.

49. *Marasmius confertus* Berk. & Broome, J. Linn. Soc., Bot. 14: 34. 1873. (Figs 57-7, 58)
= *Marasmius chondripes* Berk. & Broome, J. Linn. Soc., Bot. 14: 36. 1873.
= *Marasmius hemibaphus* Berk. & Broome, J. Linn. Soc., Bot. 14: 39. 1873.

Pileus 18-24(-40) mm diam., convex to broadly convex, subumbonate, smooth to striatulate, glabrous, dull, disc brown to dark brown (7E-F8) or reddish brown (8E-F8), margin brownish orange (5C4-5) to yellowish brown (5E8), hygrophanous, disc fading to light brown (6D6). *Context* thin, orangish grey (5B3). *Lamellae* adnexed to adnate, close (15-18) with 3-4 series of lamellulae, broad (2-3 mm), pale greyish yellow, non-marginate or slightly pale brown-marginate, non-intervenose. *Stipe* $53-83 \times 1-2$ mm, central, cylindrical, wiry, hollow, glabrous, non-insititious, light brown (5D6) overall. *Odor* of coconut juice. *Taste* not distinctive.

Basidiospores $8-10(-12) \times 4-5(-6) \mu\text{m}$ [$x_{mr} = 9.3-9.8 \times 4.3-5.1 \mu\text{m}$, $x_{mm} = 9.6 \pm 0.3 \times 4.8 \pm 0.4 \mu\text{m}$, $Q_{mr} = 1.9-2.2$, $Q_{mm} = 2.1 \pm 0.1$, $n = 25$ spores, $s = 3$ specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* cylindrical to clavate. *Cheilocystidia* scattered, of *Siccus*-type broom cells; main body $9-16 \times 4-7 \mu\text{m}$, cylindrical to fusoid, hyaline, inamyloid,

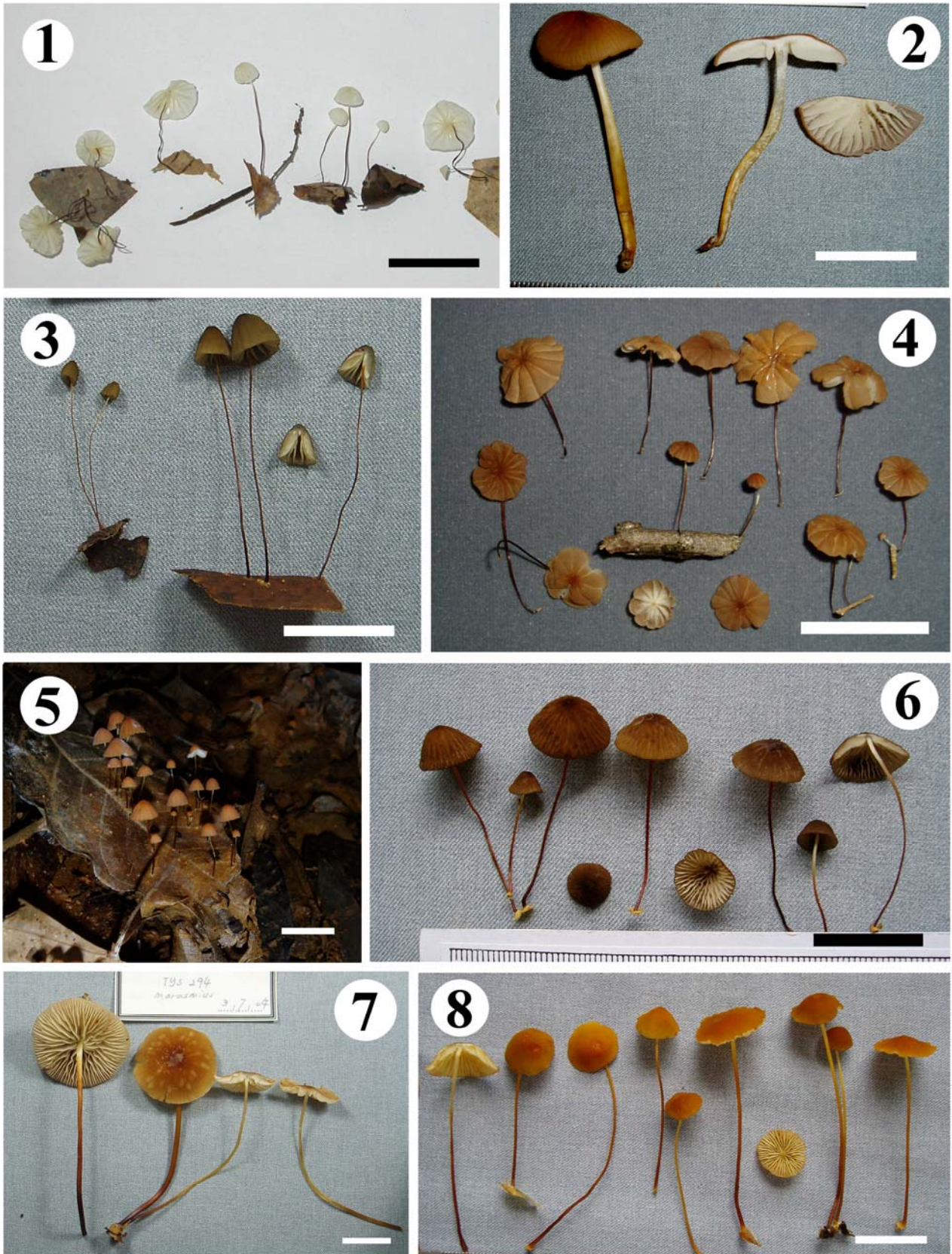


Fig. 57. Basidiomata of *Marasmius* section *Sicci* ser. *Leonini*. and ser. *Haematocephali* 1. *M. cremeus* (N. Wannathes 154) 2. *M. hypochroides* (N. Wannathes 335) 3. *M. makok* (N. Wannathes 201) 4. *M. imitarius* (N. Wannathes 423) 5. *M. bambusiniiformis* (N. Wannathes 410) 6. *M. brunneoolivascens* (N. Wannathes 277) 7. *M. confertus* (Y.S. Tan 294) 8. *M. sutepensis* (N. Wannathes 309).

thin-walled; apical setulae 3-7(-11) × 1(-2) μm, cylindrical, obtuse to subacute, hyaline, thin-walled. *Pleurocystidia* common, 38-52 × 7-13 μm, cylindrical to fusoid or irregular in outline, wavy to constricted at the apex, hyaline, inamyloid, thin-walled. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body (5-)8-14 × 4-7 μm, cylindrical to clavate or irregular in outline, often branched, light brown, inamyloid, thin- to thick-walled; apical setulae 4-11(-20) × 1-1.5(-2) μm, crowded, cylindrical, obtuse to subacute, brown, thick-walled. *Pileus trama* interwoven, dextrinoid.

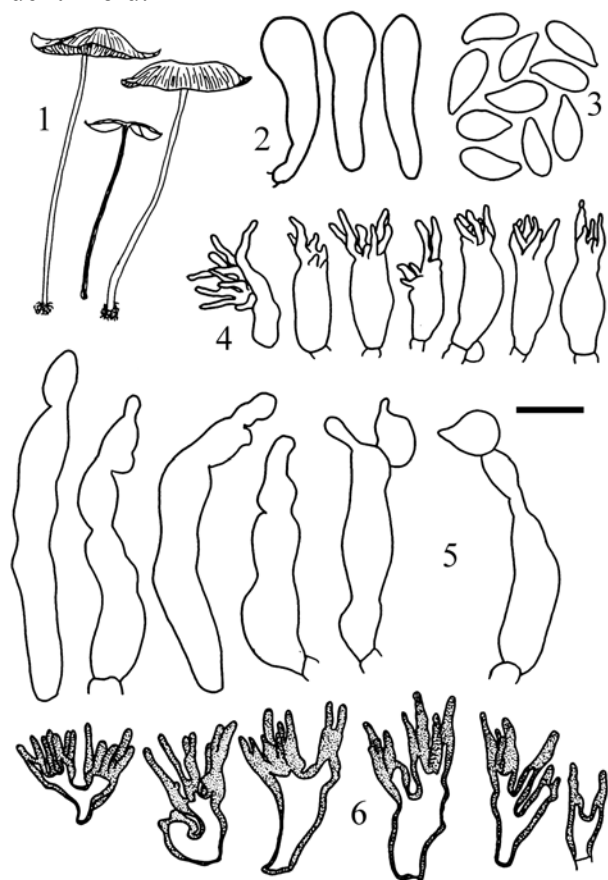


Fig. 58. *Marasmius confertus* (Y.S. Tan 294). 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5. Pleurocystidia 6. Pileipellis, Scale bar 1 = 20 mm, 2-6 = 10 μm

Lamellar trama hyphae 3-10(-14) μm diam., interwoven to regular, cylindrical to inflated, smooth, hyaline, dextrinoid to weakly dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-7(-9) μm diam., parallel, cylindrical, yellowish brown to light brown, smooth, inamyloid, thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 7-14 μm diam., parallel, cylindrical, hyaline, smooth,

dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves. South America (Bolivia, Brazil, Peru, Venezuela), Africa (Kenya, Uganda), Sri Lanka, and Northern Thailand.

Material examined. Thailand. Chiang Mai Province, Doi Inthanon National Park, Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., 3 July 2004, Y. S. Tan 294 and 300 (CMU, SFSU); same location, 27 June 2005, N. Wannathes 359 (CMU).

Discussion: *Marasmius confertus* is characterized by a smooth to striatulate pileus colored brownish orange to yellowish brown with brown to reddish brown disc, close (15-18) and broad lamellae, a glabrous light brown stipe, relatively small basidiospores with mean 9.6 × 4.8 μm, strangulate, cylindrical pleurocystidia, and growth on dicot leaves. The Thai specimens match quite closely with the Sri Lankan specimens reported by Pegler (1986), except for forming larger pilei (up to 40 mm vs up to 20 mm) and having broader basidiospores (4-5 μm vs 3-4 μm). The species has a widespread distribution in tropical regions, and has been recorded from Venezuela (Dennis, 1951), Bolivia, Brazil and Peru (Singer, 1965, 1976), and Kenya and Uganda (Pegler, 1977).

50. *Marasmius ganyao* Wannathes, Desjardin & Lumyong, **sp. nov.** (Fig. 59)

Mycobank: MB512426

Etymology: 'ganyao' (Thai) = long stipe; referring to the exceedingly long stipe.

Pileus 2-5 mm diametro, obtuse conicus, sulcatus usque plicatus, glaber usque pruinosis, hebetatus, disco atro usque atrobrunneo, margine brunneo vel sulcis laete brunneis usque brunneo-aurantiacis. *Contextus* aurantiaco-albus, tenuis. *Lamellae* annexae usque adnatae, distantes (6-8), angustae, flavo-albae, haud marginatae, haud intervenosae. *Stipes* 100-195 × 0.5 mm, centralis, cylindratus, filo metallico similis, tenax, glaber, insititius usque haud insititius, apice flavo-albo, basi brunnea. *Odor saporque* non propria. *Basidiosporae* 25-32 × 4-4.5 μm, cylindratae usque clavatae, laeves, hyalinae, inamyloideae, tenuitunicatae *Basidia* 36-40 × 9-10 μm, cylindrata usque clavata, 4-spora. *Basidiolae* cylindratae usque clavatae. *Cheilocystidia* vulgaris, typi *Sicci*; 9-19 × 4-8(-13) μm, cylindrata usque clavata vel adumbratim inaequabilia, hyalina, inamyloidea, tenuitunicata; setulis apicalibus 3-9 × 1-2 μm, cylindratis, saepe undulatis, raro furcatis, subacutis, pallide flavis usque flavis, crassetunicatis. *Pleurocystidia* vulgaris, 51-

82 × 7-13 μm, cylindrata usque fusoidea, plerumque constricta ad apicem, hyalina, inamyloidea, tenuitunicata, raro crassetunicata ad apicem. *Pileipellis* hymeniformis, maculosus, typi *Sicci*; (5-)10-19 × 5-12 μm, cylindratus usque clavatus vel adumbratim inaequabilis, saepe ramosus, pallide flavus, inamyloideus, tenui- usque crassetunicatus; setulis apicalibus 2-8 × 1-2 μm, coartatis, cylindratis, undulatis, subacutis usque acutis, brunneis usque atrobrunneis, crassetunicatis. *Trama pilei* intertexta, dextrinoidea. *Trama lamellarum* intertexta, hyphis 3-7 μm diametro, cylindratis usque inflatis, laevibus, hyalinis, leniter dextrinoideis, tenuitunicatis, haud gelatinosis. *Stipitipellis* subparallelus, hyphis 2-5 μm diametro, cylindratis, brunneis usque laete brunneis, laevibus, inamyloideis usque leniter dextrinoideis, tenui- usque crassetunicatis, haud gelatinosis. *Trama stipitis* parallela, hyphis 3-8 μm diametro, cylindratis, hyalinis, laevibus, inamyloideis, tenui- usque crassetunicatis, haud gelatinosis. *Caulocystidia* nulla. *Fibulae* praesentes in omnibus texturis.

Typus. Chiang Mai Province, Huai Nam Dang National Park, North 19° 18.3' E 98° 35.8' alt. 1,538 m., dispersus usque gregarius in folis bambusae, 24 June 2003, N. Wannathes 005 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 2-5 mm diam., obtusely conical, sulcate to plicate, glabrous to pruinose, dull, disc black to dark brown, margin brown or with light brown to brownish orange sulcae. *Context* thin, orangish white. *Lamellae* adnexed to adnate, distant (6-8), narrow, yellowish white, non-marginate, non-intervenose. *Stipe* 100-195 × 0.5 mm, central, cylindrical, wiry, tough, glabrous, insititious to non-insititious, apex yellowish white, base brown. *Odor* and *taste* not distinctive.

Basidiospores 25-32 × 4-4.5 μm [$x_{mr} = 28.2-28.3 \times 4.1-4.6 \mu\text{m}$, $x_{mm} = 28.2 \pm 0.1 \times 4.3 \pm 0.4 \mu\text{m}$, $Q_{mr} = 6.2-7.0$, $Q_{mm} = 6.6 \pm 0.6$, $n = 25$ spores, $s = 2$ specimens], cylindrical to clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* 36-40 × 9-10 μm, cylindrical to clavate, 4-spored. *Basidioles* cylindrical to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 9-19 × 4-8(-13) μm, cylindrical to clavate or irregular in outline, hyaline, inamyloid, thin-walled; apical setulae 3-9 × 1-2 μm, cylindrical, often wavy, seldom forked, subacute, pale yellow to yellow, thick-walled. *Pleurocystidia* common, 51-82 × 7-13 μm, cylindrical to fusoid, usually constricted at the apex, hyaline, inamyloid, thin-walled, rarely apically thick-walled. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body (5-) 10-19 × 5-12 μm, cylindrical to clavate or irregular in outline,

often branched, pale yellow, inamyloid, thin- to thick walled; apical setulae 2-8 × 1-2 μm, crowded, cylindrical, wavy, subacute to acute, brown to dark brown, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 3-7 μm diam., interwoven, cylindrical

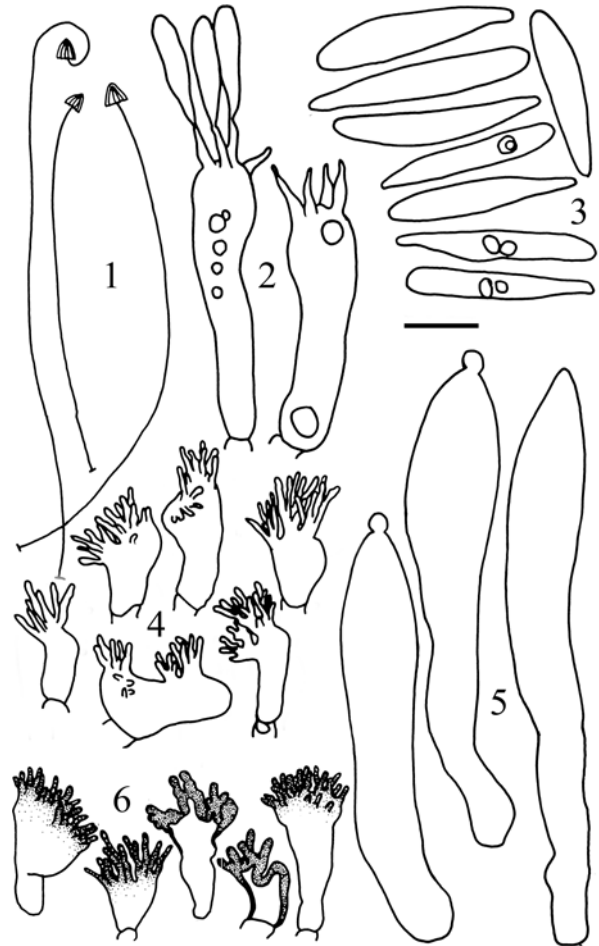


Fig. 59 *Marasmius ganyao* (N. Wannathes 183). 1. Basidiomes 2. Basidia 3. Basidiospores 4. Cheilocystidia 5. Pleurocystidia 6. Pileipellis, Scale bar 1 = 20 mm, 2-6 = 10 μm

to inflated, smooth, hyaline, weakly dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 2-5 μm diam., subparallel, cylindrical, brown to light brown, smooth, inamyloid to weakly dextrinoid, thin- to thick-walled, non-gelatinous. *Stipe trama* hyphae 3-8 μm diam., parallel, cylindrical, hyaline, smooth, inamyloid, thin- to thick-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on bamboo leaves, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Huai Nam Dang National Park, North 19°

18.3° E 98° 35.8' alt. 1,538 m., 24 June 2003, N. Wannathes 005 (CMU: **holotype**; SFSU: **isotype**); same location, 28 June 2004, N. Wannathes 183 (CMU, SFSU)

Discussion: The new species is distinguished by a small obtusely conical, sulcate pileus with a black to dark brown disc and brown margin with paler sulcae, distant (6-8), narrow lamellae, a long (up to 195 mm long), wiry, brown stipe that is often insititious and grows on bamboo leaves, long clavate basidiospores with mean $28.2 \times 4.3 \mu\text{m}$, and simple strangulate pleurocystidia. *Marasmius ganyao* is similar to the following species. *Marasmius davidii* Antonín, a species previously known as *M. brunneolus* (Berk. & Broome) Pegler (non *M. brunneolus* (Beeli) Singer; cf. Antonín, 2003) and described from Sri Lanka, differs in forming larger pilei (7-11 mm vs 2-5 mm), a shorter stipe (30-45 mm), smaller basidiospores ($20-27 \times 4-6 \mu\text{m}$, $x_m = 22 \times 4.5 \mu\text{m}$), and has a lignicolous habit (Pegler, 1986). *Marasmius longistipitatus* Antonín, from Africa, differs in forming a pale greyish orange to orangish white pileus with a distinct conical papilla, more numerous and pseudocollariate lamellae (9-12), a reddish orange to brownish orange stipe, and slightly smaller basidiospores ($20-28 \times 4.5-6 \mu\text{m}$) (Antonín, 2007). *Marasmius megistosporus* Singer, described from Bolivia, differs in forming larger pilei (up to 35 mm diam.) with deep ferruginous to golden brown margin, possibly longer basidiospores (28-37.5 μm long), and has a lignicolous habit (Singer, 1965, 1976).

51. *Marasmius graminipes* Wannathes, Desjardin & Lumyong, **sp. nov.** (Fig. 60)
MycoBank: MB512427

Etymology: 'graminipes' (Latin) = grass-stem; referring to the tufts of grass-like caulocystidia on the stipe surface.

Pileus 8-23 mm diametro, campanulatus, striatus, glaber, hebetatus, disco atrobrunneo, margine brunneo-cinereus. **Contextus** brunneo-creameus, tenuis. **Lamellae** annexae, arctae (20-24) cum 3 seriebus lamellularum, latae, cinereo-albae, haud marginatae, haud intervenosae. **Stipes** 35-45 \times 1.5-2.5 mm, centralis, cylindratus, pruinosa, haud insititius, apice brunneo-flavo, basi brunnea. **Odor saporque** non propria. **Basidiosporae** 18-21(-22) \times 4 μm , anguste clavatae usque cylindratae, laeves, hyalinae, inamyloideae, tenuitunicatae **Basidia** non observata. **Basidiolae** clavatae. **Cheilocystidia** vulgaris, typi *Sicci*; 10-15 \times 5-6 μm , cylindrata usque

clavata, hyalina, inamyloidea, tenuitunicata; setulis apicalibus 3-12(-16) \times 1-1.5(-2) μm , cylindratis, saepe undulatis, raro furcatis, subacutis, hyalinis, tenuitunicatis. **Pleurocystidia** dispersa usque rara, 45-47 \times 8-10 μm , cylindrata usque fusioidea, plerumque undulata vel constricta ad apicem, hyalina, inamyloidea, tenuitunicata. **Pileipellis** hymeniformis, maculosus, typi *Sicci*; 12-27 \times 8-12 μm , clavatus usque late clavatus vel turbinatus, hyalinus, inamyloideus, tenui- usque crassetunicatus; setulis apicalibus 5-18 \times 1-2 μm , coartatis, cylindratis, subacutis, atrobrunneis, crassetunicatis. **Trama pilei** intertexta, hyphis 5-10 μm diametro, cylindratis usque inflatis, laevis, hyalinis, dextrinoideis, tenuitunicatis. **Trama lamellae** regularis usque intertexta, hyphis 5-12 μm diametro, cylindratis, laevis, hyalinis, leniter dextrinoideis, tenuitunicatis, haud gelatinosis. **Stipitipellis** parallelus, hyphis 4-9(-11) μm diametro, cylindratis, flavis usque laete brunneis, laevis, inamyloideis, tenuitunicatis, haud gelatinosis. **Trama stipitis** parallela, hyphis 6-8 μm diametro, cylindratis, hyalinis, laevis, dextrinoideis, tenuitunicatis, haud gelatinosis. **Caulocystidia** abundantia, plerumque caespitosa, typi *Sicci*; 6-28 \times 7-8 μm , cylindrata, hyalina usque pallide flava, inamyloidea, tenuitunicata; setulis apicalibus 5-40 \times 1.5-2 μm , cylindratis, saepe furcatis, conicis usque subacutis, flavis, crassetunicatis (usque ad 1 μm). **Fibulae** praesentes in omnibus texturis.

Typus: Chiang Mai Province, Doi Inthanon National Park, Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., dispersus usque gregarius in ligno vel folis plantae dicotyledoneae, 2 August 2003, N. Wannathes 078 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 8-23 mm diam., campanulate, striate, glabrous, dull, disc dark brown, margin brownish grey. **Context** thin, brownish cream. **Lamellae** adnexed, close (20-24) with 3 series of lamellulae, broad, greyish white, non-marginate, non-intervenose. **Stipe** 35-45 \times 1.5-2.5 mm, central, cylindrical, pruinose, non-insititious, apex brownish yellow, base brown. **Odor** and **taste** not distinctive.

Basidiosporae 18-21(-22) \times 4 μm [$x = 19.3 \pm 1.0 \times 4.0 \pm 0 \mu\text{m}$, $Q = 4.5-5.5$, $Q_m = 4.8$, $n = 25$ spores, $s = 1$ specimen], narrowly clavate to cylindrical, smooth, hyaline, inamyloid, thin-walled. **Basidia** not observed. **Basidioles** clavate. **Cheilocystidia** common, of *Siccus*-type broom cells; main body 10-15 \times 5-6 μm , cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae 3-12(-16) \times 1-1.5(-2) μm , cylindrical, often wavy, seldom forked, subacute, hyaline, thin-walled. **Pleurocystidia** scattered to rarely present, 45-47 \times 8-10 μm , cylindrical to fusoid, usually wavy or constricted at the apex, hyaline, inamyloid, thin-

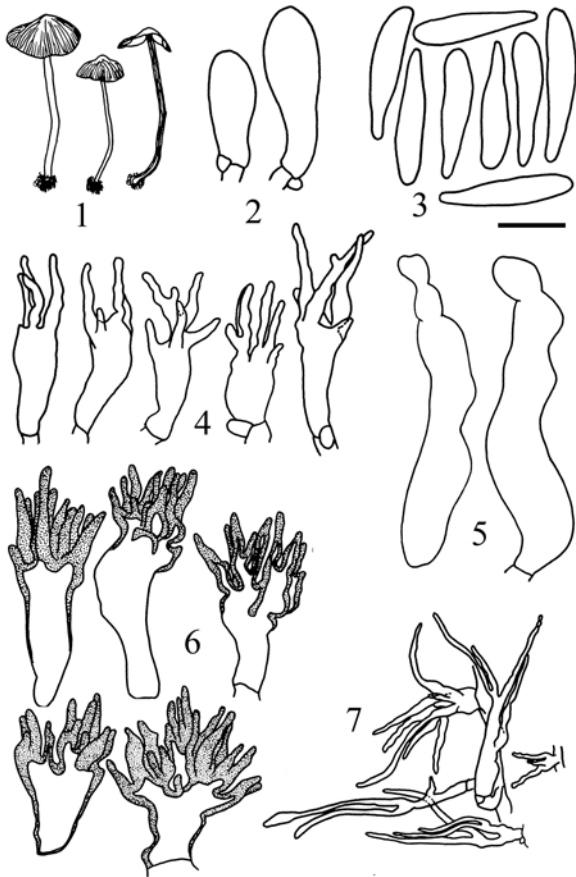


Fig. 60. *Marasmius graminipes* (N. Wannathes 078). 1. Basidiomes 2. Basidioles 3. Basidiospores 4. Cheilocystidia 5. Pleurocystidia 6. Pileipellis 7. Caulocystidia, Scale bar 1 = 20 mm, 2-7 = 10 μ m

walled. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 12-27 \times 8-12 μ m, clavate to broadly clavate or turbinate, hyaline, inamyloid, thin- to thick-walled; apical setulae 5-18 \times 1-2 μ m, crowded, cylindrical, subacute, dark brown, thick-walled. *Pileus trama* hyphae 5-10 μ m diam., interwoven, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled. *Lamellar trama* hyphae 5-12 μ m diam., regular to interwoven, cylindrical, smooth, hyaline, weakly dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 4-9(-11) μ m diam., parallel, cylindrical, yellow to light brown, smooth, inamyloid, thin-walled, non-gelatinous. *Stipe trama* hyphae 6-8 μ m diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* abundant, usually present in cespitose clusters of many cells, composed of *Siccus*-type broom cells with main body 6-28 \times 7-8 μ m, cylindrical, hyaline to pale yellow, inamyloid, thin-walled; apical setulae 5-40 \times 1.5-2 μ m, cylindrical,

often forked, conical to subacute, yellow, slightly thick-walled (up to 1 μ m). *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on wood or on dicotyledonous leaves, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Inthanon National Park, Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., 2 August 2003, N. Wannathes 078 (CMU: **holotype**; SFSU: **isotype**).

Discussion: Distinctive features of *M. graminipes* include: a striate, brownish grey pileus with dark brown disc; close (20-24), broad, greyish white lamellae; a brown, pruinose stipe; narrowly clavate basidiospores with mean 19.3 \times 4 μ m; simple, strangulate pleurocystidia; and numerous grass-like tufts of *Siccus*-type broom cells on the stipe surface. The new species is similar to several brown-colored Asian species. *Marasmius coklatus* (No. 31) differs in forming smaller basidiospores (mean 11.2 \times 6.1 μ m), and numerous hymenial setae, pileosetae and caulosetae. *Marasmius nummularioides* Desjardin & Y.S. Tan, described from Malaysia, differs in forming a non-striate pileus coloured more reddish brown, fewer lamellae (16-18) with brown edges, smaller basidiospores (mean 16.7 \times 4.1 μ m), and *Siccus*-type broom cells on the stipe surface with more well-developed basal cells, although they do form setulae up to 60 μ m long (Tan *et al.*, 2007). *Marasmius bondoi* (see below) differs in forming slightly smaller basidiospores with mean range 14.2-18.3 \times 3.5-4.0 μ m, fewer lamellae (12-18), and a golden brown stipe that lacks caulocystidia. Although in the ML phylogenetic tree (Fig. 1) the presence of *M. graminipes* makes *M. bondoi* paraphyletic, a separate branch and bound analysis of a subset including only *M. bondoi* and *M. graminipes* isolates with *M. plicatulus* Peck as an outgroup (Fig. 74), indicates that *M. graminipes* is sister to all *M. bondoi* isolates and supports our recognition of *M. graminipes* as a distinct taxon.

52. *Marasmius brunneoolivascens* Wannathes, Desjardin & Lumyong, **sp. nov.**

(Figs 59-6, 61)

Mycobank: MB512428

Etymology: 'brunneo' (Latin) = brown, 'olivascens' (Latin) = olive; referring to the olive brown color of the pileus and lamellae.

Pileus 6-23 mm diametro, convexus cum umbone rugoso ubi iuvenis, expansus et plano-convexus et leviter depressus ubi vetus, striatus usque sulcatus, pruinosis, hebetatus, primo ubique atrobrunneus demum disco atrobrunneo et margine brunneo usque cinereo-brunneo. *Contextus* cinereo-cremeus, tenuis. *Lamellae* annexae usque liberae, subdistantes (12-18) cum 2-3 seriebus lamellarum, latae (1-2 mm), olivaceo-brunneae usque cinereo-olivaceae vel flavo-olivaceae, saepe brunneo-marginatae usque olivaceo-brunneomarginatae, haud intervenosae. *Stipes* 15-55 × 0.5-1 mm, centralis, cylindricus, filo metallico similis, cavus, glaber, haud insititius, apice flavo-albo, basi brunnea usque rubro brunnea. *Odor* *saporque* non propria. *Basidiosporae* (11-)12-14(-15) × 4-5(-6) μm, fusoidae, inaequilaterales, laeves, hyalinae, inamyloideae, tenuitunicatae *Basidia* 20-22 × 6-8 μm, cylindrica usque clavata, 4-spora. *Basidiolae* fusoidae usque clavatae. *Cheilocystidia* abundantia, typi *Sicci*; 12-28 × 5-9 μm, cylindrica usque clavata, interdum catenulata, hyalina, inamyloidea, tenuitunicata; setulis apicalibus 2-9(-10) × 1-1.5 μm, cylindricis, subacutis, flavis usque brunneis, crassetunicatis. *Pleurocystidia* 2 typorum: a) cellulis typi *Sicci*, cheilocystidio similibus, dispersis, raris, 12-22 × 6-8 μm, cylindricis usque clavatis, hyalinis, inamyloideis, tenuitunicatis; setulis apicalibus 2-7 × 1-1.5 μm, cylindricis, subacutis, flavis, inamyloideis, crassetunicatis; b) cellulis haud setulosis 30-50 × 5-9 μm, cylindricis usque clavatis, constrictis et interdum lobatis ad apicem, hyalinis, inamyloideis, tenuitunicatis. *Pileipellis* hymeniformis, maculosus, typi *Sicci*; 8-23 × 5-12 μm, cylindricus usque clavatus vel pyriformis, saepe ramosus, hyalinus usque pallide flavus, inamyloideus, tenui- usque crassetunicatus; setulis apicalibus 2-7(-12) × 1-1.5(-2.5) μm, coartatis, cylindricis, subacutis usque acutis, brunneis usque atrobrunneis, crassetunicatis. *Trama pilei* intertexta, dextrinoidea usque fortiter dextrinoidea. *Trama lamellae* intertexta usque regularis, hyphis 3-8(-22) μm diametro, cylindricis usque inflatis, laevibus, hyalinis, dextrinoideis usque fortiter dextrinoideis, tenuitunicatis, haud gelatinosis. *Stipitipellis* subparallelus, hyphis 3-9(-13) μm diametro, cylindricis, brunneis usque laete brunneis, laevibus, dextrinoideis, crassetunicatis (usque ad 3 μm), haud gelatinosis. *Trama stipitis* parallela, hyphis (3-)5-13(-20) μm diametro, cylindricis, hyalinis usque pallide flavis, laevibus, dextrinoideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* nulla. *Fibulae* praesentes in omnibus texturis.

Typus: Chiang Mai Province, Doi Suthep-Pui National Park, Sangasabhasri Land on the way to Huai Kok Ma Village, N 18° 48.4' E 98° 54.6' alt. 1,146 m., dispersus usque gregarius in folis plantae dicotyledoneae vel ligno, 14 August 2003, N. Wannathes 112 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 6-23 mm diam., convex with a rugulose umbo when young, expanding to plano-convex and slightly depressed in age, striate to sulcate, pruinose, dull, dark brown overall when young, in age disc dark brown

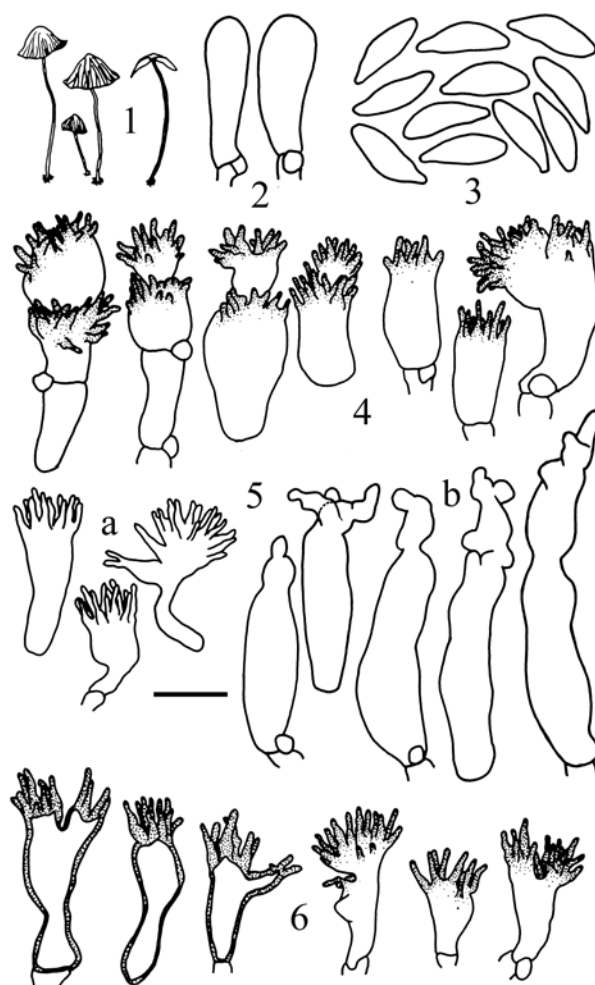


Fig. 61. *Marasmius brunneoolivascens* (N. Wannathes 227). 1. Basidiomes 2. Basidiolae 3. Basidiospores 4. Cheilocystidia 5a. *Siccus*-type pleurocystidia 5b. Non-setulose pleurocystidia 6. Pileipellis, Scale bar 1 = 20 mm, 2-6 = 10 μm

and margin brown to greyish brown. *Context* greyish cream, thin. *Lamellae* adnexed to free, subdistant (12-18) with 2-3 series of lamellulae, broad (1-2 mm), olive brown to greyish olive or yellowish olive, sometimes with brown to olive-brown edges, non-intervenose. *Stipe* 15-55 × 0.5-1 mm, central, cylindrical, wiry, hollow, glabrous, non-insititious, apex yellowish white, base brown to reddish brown. *Odor* and *taste* not distinctive.

Basidiospores (11-)12-14(-15) × 4-5(-6) μm [$x_{mr} = 12.6-13.8 \times 4.0-5.0$, $x_{mm} = 13.0 \pm 0.3 \times 4.4 \pm 0.4$ μm, μm, $Q_{mr} = 2.7-3.4$, $Q_{mm} = 3.0 \pm 0.2$, n = 25 spores, s = 11 specimens], fusoid, inequilateral, smooth, hyaline, inamyloid, thin-walled. *Basidia* 20-22 × 6-8 μm, cylindrical to clavate, 4-spored. *Basidiolae* fusoid to clavate. *Cheilocystidia* abundant, of *Siccus*-type broom cells; main body 12-28 × 5-9 μm, cylindrical to

clavate, sometimes catenulate, hyaline, inamyloid, thin-walled; apical setulae 2-9(-10) × 1-1.5 µm, cylindrical, subacute, yellow to brown, thick-walled. *Pleurocystidia* composed of 2 type of cells: a) *Siccus*-type broom cells like the cheilocystidia, scattered and rare; main body 12-22 × 6-8 µm, cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae 2-7 × 1-1.5 µm, cylindrical, subacute, yellow, inamyloid, thick-walled; b) non-setulose cells, 30-50 × 5-9 µm, cylindrical to clavate, constricted and sometimes lobed at the apex, hyaline, inamyloid, thin-walled. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 8-23 × 5-12 µm, cylindrical to clavate or pyriform, often branched, hyaline to pale yellow, inamyloid, thin-to thick-walled; apical setulae 2-7(-12) × 1-1.5(-2.5) µm, crowded, cylindrical, subacute to acute, brown to dark brown, thick-walled. *Pileus trama* interwoven, dextrinoid to strongly dextrinoid. *Lamellar trama* hyphae 3-8(-22) µm diam., interwoven to regular, cylindrical to inflated, smooth, hyaline, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-9(-13) µm diam., subparallel, cylindrical, brown to light brown, smooth, dextrinoid, thick-walled (up to 3 µm), non-gelatinous. *Stipe trama* hyphae (3-)5-13(-20) µm diam., parallel, cylindrical, hyaline to pale yellow, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves or on wood, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Sangasabhasri Land on the way to Huai Kok Ma Village, N 18° 48.4' E 98° 54.6' alt. 1,146 m., 29 July 2003, N. Wannathes 055 (CMU, SFSU); same location, 14 August 2003, N. Wannathes 112 (CMU: **holotype**; SFSU: **isotype**) and N. Wannathes 113 (CMU); same location, 16 July 2004, N. Wannathes 228 (CMU); same location, 24 June 2005, N. Wannathes 322 (CMU); Chiang Mai Province, Mae Taeng District, Tung Joaw Village, N 19° 8.07' E 98° 38.9' alt. 1423 m., 31 July 2003, N. Wannathes 063 (CMU, SFSU); same location, 22 August 2004, N. Wannathes 277 (CMU, SFSU); Chiang Mai Province, Huai Nam Dang National Park, North 19° 18.3' E 98° 35.8' alt. 1,538 m., 29 June 2005, N. Wannathes 373 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Medicinal Plant Garden, 3 August 2005, N. Wannathes 397 (CMU, SFSU).

Discussion: *Marasmius brunneoolivascens* is characterized by a striate to sulcate pileus coloured brown to greyish brown with a dark brown disc, subdistant (12-18) broad lamellae colored olive brown to greyish olive or yellowish olive with or without brown to olive brown edges, a glabrous stipe, fusoid basidiospores with mean 13.0 × 4.4 µm and mean Q = 3, two types of pleurocystidia (simple strangulate cells and scattered *Siccus*-type broom cells), and an absence of caulocystidia. This new species is similar to two African species. *Marasmius grandisetulosus* Singer differs in forming white to cream-coloured lamellae, longer basidiospores (17-23 µm long) and lacks olive tones (Singer, 1964; Antonín, 2007). *Marasmius elaeocephalus* Singer *sensu* Antonín (2007) differs in forming an olive brown pileus with yellow tones on the margin, yellowish white lamellae with concolorous edges, and lacks two types of pleurocystidia.

53. *Marasmius suthepensis* Wannathes, Desjardin & Lumyong, **sp. nov.**

(Figs 59-8, 62)

Mycobank: MB512429

Etymology: '*suthep*' = Doi Suthep-Pui National Park; referring to the place where the holotype specimen was collected.

Pileus 10-27 mm diametro, obtuse conicus usque convexus, cum vel sine umbone, laevis usque striatus, glaber, hebetatus, disco clare brunneo, margine brunneo-flavo usque brunneo-aurantiaco. *Contextus* flavo-albus, tenuis. *Lamellae* annexae usque liberae, subdistantes (12-18) cum 3-4 seriebus lamellularum, latae (1-2 mm), pallide flavo-albae, haud marginatae, haud intervenosae. *Stipes* 18-55 × 1 mm, centralis, cylindratus, filo metallico similis, cavus, glaber, haud insititius, apice flavo-albo, basi brunnea. *Odor saporque* non propria. *Basidiosporae* (10-)11-14(-15) × (3.5-)4-5 µm, anguste ellipsoideae usque fusoideae, laeves, hyalinae, inamyloideae, tenuitunicatae *Basidia* 13-15 × 5-6 µm, cylindrata usque clavata, 4-spora. *Basidiolae* cylindratae usque clavatae. *Cheilocystidia* abundantia, typi *Sicci*; (6-)12-18 × (3-)7-11 µm, cylindrata usque clavata, hyalina, inamyloidea, tenuitunicata; setulis apicalibus 2-6 × 1 µm, cylindratis usque conicis, obtusis usque subacutis, flavis usque flavo-brunneis, tenuitunicatis. *Pleurocystidia* vulgaris, 27-43 × 5-7 µm, cylindrata usque fusoidea, undulata usque constricta et interdum lobata ad apicem, hyalina, inamyloidea, tenuitunicata. *Pileipellis* hymeniformis, maculosus, typi *Sicci*; (7-)10-17(-22) × 4-10 µm, cylindratus usque clavatus vel pyriformis, hyalinus usque pallide flavus, inamyloideus, tenuitunicatus; setulis apicalibus 3-8 × 1(-1.5) µm, coartatis, cylindratis, subacutis, brunneis usque laete brunneis, crassetunicatis.

Trama pilei intertexta, hyphis (4-)6-13(-17) μm diametro, cylindratis usque inflatis, laevibus, hyalinis, fortiter dextrinoideis, tenuitunicatis. *Trama lamellae* intertexta usque regularis, hyphis 3-7(-12) μm diametro, cylindratis usque inflatis, laevibus, hyalinis, dextrinoideis, tenuitunicatis, haud gelatinosis. *Stipitipellis* subparallelus, hyphis 3-7(-9) μm diametro, cylindratis, brunneis usque atrobrunneis, laevibus, inamyloideis usque leniter dextrinoideis, tenuitunicatis, haud gelatinosis. *Trama stipitis* parallela, hyphis (3-)5-10(-13) μm diametro, cylindratis, hyalinis, laevibus, dextrinoideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* nulla. *Fibulae* praesentes in omnibus texturis.

Typus: Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5'.E 98° 46.3' alt. 1014 m., dispersus usque gregarius in folis plantae dicotyledoneae vel ligno, 29 June 2004, Y.S. Tan 280 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 10-27 mm diam., obtusely conical to convex, with or without an umbo, smooth to striate, glabrous, dull, disc bright brown, margin brownish yellow to brownish orange. *Context* thin, yellowish white. *Lamellae* adnexed to free, subdistant (12-18) with 3-4 series of lamellulae, broad (1-2 mm), pale yellowish white, non-marginate, non-intervenose. *Stipe* 18-55 \times 1 mm, central, cylindrical, wiry, hollow, glabrous, non-insititious, apex yellowish white, base brown. *Odor* and *taste* not distinctive.

Basidiospores (10-)11-14(-15) \times (3.5-)4-5 μm [$x_{\text{mr}} = 11.7-13.6 \times 3.9-4.1 \mu\text{m}$, $x_{\text{mm}} = 12.6 \pm 1.0 \times 4.0 \pm 0.1 \mu\text{m}$, $Q_{\text{mr}} = 2.9-3.8$, $Q_{\text{mm}} = 3.7 \pm 1.0$, $n = 25$ spores, $s = 3$ specimens], narrowly ellipsoid to fusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 13-15 \times 5-6 μm , cylindrical to clavate, 4-spored. *Basidioles* cylindrical to clavate. *Cheilocystidia* abundant, of *Siccus*-type broom cells; main body (6-)12-18 \times (3-)7-11 μm , cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae 2-6 \times 1 μm , cylindrical to conical, obtuse to subacute, yellow to yellowish brown, thin-walled. *Pleurocystidia* common, 27-43 \times 5-7 μm , cylindrical to fusoid, wavy to constricted and sometimes lobed at the apex, hyaline, inamyloid, thin-walled. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body (7-)10-17(-22) \times 4-10 μm , cylindrical to clavate or pyriform, hyaline to pale yellow, inamyloid, thin-walled; apical setulae 3-8 \times 1(-1.5) μm , crowded, cylindrical, subacute, brown to light brown, thick-walled. *Pileus trama*

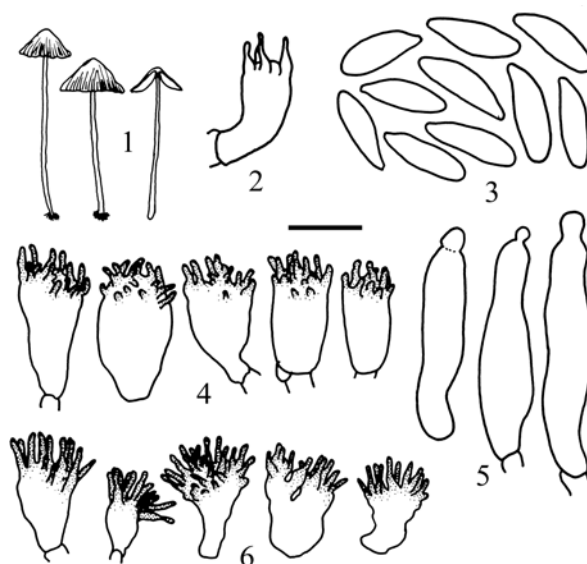


Fig. 62. *Marasmius suthepensis* (Y.S. Tan 280). 1. Basidiomes 2. Basidia 3. Basidiospores 4. Cheilocystidia 5. Pleurocystidia 6. Pileipellis, Scale bar 1 = 20 mm, 2-6 = 10 μm

hyphae (4-)6-13(-17) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, strongly dextrinoid, thin-walled. *Lamellar* hyphae 3-7(-12) μm diam., *trama* interwoven to regular, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-7(-9) μm diam., subparallel, cylindrical, brown to dark brown, smooth, inamyloid to weakly dextrinoid, thin-walled, non-gelatinous. *Stipe trama* hyphae (3-)5-10(-13) μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution. Scattered to gregarious on dicotyledonous leaves or on wood, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Sangasabhasri Land on the way to Huai Kok Ma Village, N 18° 48.4' E 98° 54.6' alt. 1,146 m., 30 June 2003, N. Wannathes 012 (CMU, SFSU); same location, 29 July 2003, N. Wannathes 057 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5'.E 98° 46.3' alt. 1014 m., 29 June 2004, Y.S. Tan 280 (CMU: **holotype**; SFSU: **isotype**).

Discussion: Diagnostic features of *Marasmius suthepensis* include: a smooth to striate pileus coloured brownish yellow to brownish orange with bright brown disc; subdistant (12-18), broad lamellae that are pale yellowish white and non-marginate; a glabrous, brown stipe; basidiospores with mean 12.6 \times

4.0 μm and mean $Q = 3.7$; simple cylindrical pleurocystidia, and an absence of caulocystidia. The Thai new species is similar to two brown-coloured neotropical species. *Marasmius hinnuleus* Berk. & M.A. Curtis, described from Cuba, differs in forming smaller (4-12 mm vs 10-27 mm), sulcate to plicate pilei coloured pale reddish brown to cinnamon-rufous, and slightly longer spores with mean $14 \times 3.8 \mu\text{m}$ (Singer, 1976; Pegler, 1983). *Marasmius helvolus* Berk., described from Brazil, differs in forming distinctly sulcate to plicate pilei, fewer lamellae (9-11) and usually lacks pleurocystidia (rare in some basidiomes) (Singer, 1976; Pegler, 1983; Desjardin and Ovrebo, 2006). *Marasmius suthepensis* is also similar to *M. brunneoolivascens* (see above), which may occur at the same site, but the latter species differs in forming olive toned lamellae and *Siccus*-type broom cells are often present as pleurocystidia on the lamellar sides.

54. *Marasmius haematocephalus* (Mont.) Fr., Epicr. Syst. Mycol: 382. 1838.

≡ *Agaricus haematocephalus* Mont. Ann. Sci. Nat., Bot., sér. 2, 8: 369. 1837.

≡ *Androsaceus haematocephalus* (Mont.) Pat., J. Bot. (Morot) 3: 336. 1889.

= *Marasmius rhodocephalus* Fr., Nova Acta Regiae Soc. Sci. Upsal ser. 3, 1: 31. 1851.

≡ *Androsaceus rhodocephalus* (Fr.) Pat. & Gaillard, Bull. Soc. Mycol. France 4: 20. 1888.

= *Marasmius semipellucidus* Berk. & Broome, J. Linn. Soc., Bot. 14: 36. 1873.

= *Marasmius sanguineus* Cooke & Masee, Grevillea 17: 59. 1889.

= *Marasmius atropurpureus* Murrill, N. Amer. Fl. 9: 262. 1915.

= *Marasmius vinosus* Beeli, Bull. Soc. Roy. Bot. Belgique 60: 158. 1928.

There occur in Thailand six distinct forms of *M. haematocephalus*, that share basidiospores in the range $19\text{-}25 \times 3.5\text{-}5 \mu\text{m}$ with $x_{\text{mm}} = 20.7 \times 4.0 \mu\text{m}$ and $Q_{\text{mm}} = 5.2$, well-developed, simple and stragulate pleurocystidia, two types of cheilocystidia, lack caulocystidia, and fall into a well-supported clade based on ITS sequences (Fig. 1). They differ in pileus size and pigmentation, ranging from yellowish orange to deep reddish brown, maroon, dark violet, purple and purplish brown, and in substrate preference. The ITS sequence data, however, are of limited use in distinguishing the forms. A branch and bound analysis that includes sequences of all *M.*

haematocephalus forms with *M. siccus* as an outgroup (Fig. 70) indicates that several forms are well-supported by BS values 92-100% (forms *haematocephalus*, “*atrobrunneus*”, “*violaceus*”), whereas other forms show invariability (forms “*variabilis*”, “*luteocephalus*”) or form a polytomy (“*f. robustus*”). *Marasmius haematocephalus* as it occurs in Southeast Asia will remain a complex of morphologically and genetically distinct entities without formal taxonomic recognition until further specimens are analyzed in the hopes of clarifying their differences and relationships. The forms recognized below will not be formally proposed and are named herein only to aid in documenting their existence.

Key to forms of *Marasmius haematocephalus*

1. Pileus yellowish orange or with a pale brownish yellow disc and nearly white margin **54A. *M. haematocephalus* “f. luteocephalus”**
1. Pileus with red, violet, olive, greyish blue or brown pigments..... **2**
2. Pileus 1-5 mm diam, dark brown overall, lacking red, violet or purple..... **54B. *M. haematocephalus* “f. atrobrunneus”**
2. Pileus > 5 mm diam, with red, violet, purple, olive, or greyish blue tones **3**
3. Pileus olive to greyish blue overall when young, disc often with red, orange or reddish purple tones in age **54C. *M. haematocephalus* “f. variabilis”**
3. Pileus lacking olive and greyish blue tones **4**
4. Pileus typically 10-20(-30) mm diam., dark reddish brown to dark violet brown (10-11F6-8) when young, fading to reddish-greyish brown in age..... **54D. *M. haematocephalus* “f. robustus”**
4. Pileus typically <10 mm diam, deep reddish brown to maroon or deep violet-purple..... **5**
5. Pileus magenta, deep violet-purple or dark purple (13-14E-F6-8); basidiospores normally with mean in the range $20.5\text{-}22 \times 3.8\text{-}4.2 \mu\text{m}$; basidiomes often associated with bamboo leaves **54E. *M. haematocephalus* “f. violaceus”**
5. Pileus deep reddish brown to maroon (9-11E-F7-8); basidiospores normally with mean in the range $17.5\text{-}18 \times 4.0\text{-}4.3 \mu\text{m}$; basidiomes usually associated with dicot leaves **54F. *M. haematocephalus* f. *haematocephalus***

54A *Marasmius haematocephalus* “f. luteocephalus” Wannathes, Desjardin & Lumyong, **nom. prov.** (Figs 63, 69-1)

Pileus 4-21 mm diam., convex to plano-convex, sulcate, pruinose, dull, yellowish orange overall or with disc pale brownish yellow and margin yellowish orange to yellowish white or nearly white. *Context* cream, thin. *Lamellae* free to adnexed, distant (11-13), broad (1-3 mm), cream with yellowish orange edges, non-intervenose. *Stipe* 20-42 × 0.3-0.8 mm, central, cylindrical, wiry, hollow, glabrous, non-insititious, apex yellowish white, base dark brown. *Odor* and *taste* not distinctive.

Basidiospores (20-)21-23(-24) × 3.5-4 μm [$x = 22 \pm 0.9 \times 3.7 \pm 0.3 \mu\text{m}$, $Q = 5.0-6.6$, $Q_m = 5.9$, $n = 25$ spores, $s = 1$ specimen], clavate to fusoid, often curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* composed of 2 types of cells: a) *Siccus*-type broom cells with main body 12-19 × 7-9 μm, cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae 2-5 × 1 μm, cylindrical, often forked, subacute to obtuse, hyaline to yellow, thick-walled; b) non-setulose cells like the pleurocystidia, 36-41 × 11-13 μm, fusoid, usually attenuated and strangulate at the apex, hyaline, inamyloid, thin-walled. *Pleurocystidia* common, 52-58(-62) × 10-12 μm, fusoid to clavate, usually attenuated and strangulate at the apex, hyaline, inamyloid, thin-walled. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 12-15 × 8-14 μm, clavate to broadly clavate or pyriform, sometime branched, yellow to hyaline, inamyloid, thin-walled; apical setulae 2-4 × 1 μm, cylindrical, subacute, yellow to pale yellow, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 5-10(-20) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-5 μm diam., subparallel, cylindrical, greenish brown, smooth, dextrinoid, thin- to thick-walled, non-gelatinous. *Stipe trama* hyphae (4-)7-10 μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves, Northern Thailand.

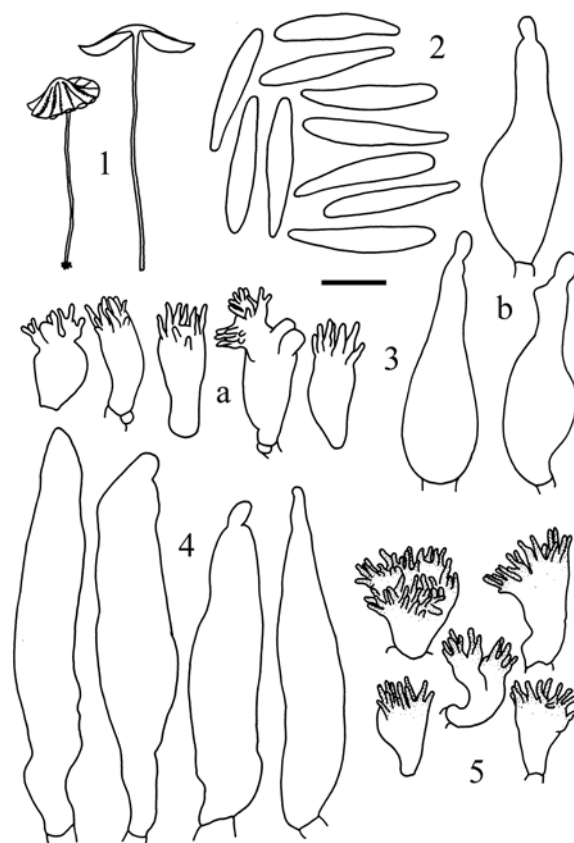


Fig. 63. *Marasmius haematocephalus* “f. *luteocephalus*” (N. Wannathes 310). 1. Basidiomes 2. Basidiospores 3a. *Siccus*-type cheilocystidia 3b. Non-setulose cheilocystidia 4. Pleurocystidia 5. Pileipellis, Scale bar 1 = 10 mm, 2-5 = 10 μm

Material examined: Thailand. Chiang Rai Province, Muang District, Khun Con Waterfall, 12 June 2005, N. Wannathes 310 (CMU, SFSU).

Discussion: *Marasmius haematocephalus* “f. *luteocephalus*” differs from all other forms in having a yellowish orange to yellowish white pileus with pale brownish yellow and cream-coloured lamellae with yellowish orange edges. This provisional taxon looks like a paler form of *M. haematocephalus* var. *leucophyllus* Singer, described from Bolivia, but the latter differs in forming a darker pileus (fawn to pinkish cinnamon), and smaller basidiospores in the range 15-20 × 3.5 μm (Singer, 1976).

54B. *Marasmius haematocephalus* “f. *atrobrunneus*” Wannathes, Desjardin & Lumyong, **nom. prov.** (Fig. 64)

Pileus 1-5 mm diam., obtusely conical to convex with or without a rugulose disc, striate,

minutely velutinous, dull, dark brown overall. *Context* brownish white, thin. *Lamellae* adnexed, distant (8-11), narrow, brownish cream, non-marginate, non-intervenose. *Stipe* 5-15 × 0.2 mm, central, cylindrical, wiry, hollow, glabrous, insititious, apex yellowish white, base brown to dark brown. *Odor* and *taste* not distinctive.

Basidiospores 17-19 × 4-5 μm [$x = 18.1 \pm 0.7 \times 4.2 \pm 0.3 \mu\text{m}$, $Q = 3.8-4.8$, $Q_m = 4.3$, $n = 25$ spores, $s = 1$ specimen], clavate to fusoid, often curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* composed of 2 types of cells: a) *Siccus*-type broom cells with main body 6-14 × 5-12 μm, cylindrical to clavate or pyriform, hyaline, inamyloid, thin-walled; apical setulae 2-4 × 1 μm, cylindrical, often forked, subacute, hyaline to yellow, thick-walled; b) non-setulose cells like the pleurocystidia, 35-40 × 7-9 μm, fusoid to clavate, usually attenuated and strangulate at the apex, often with 2-4 successive apical constrictions, hyaline inamyloid, thin-walled. *Pleurocystidia* common, 34-48 × 7-9 μm, clavate to fusoid, usually attenuated and strangulate at the apex, sometimes with 2 successive apical constrictions, hyaline, inamyloid, thin-walled. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 12-16 × 7-10 μm, clavate to broadly clavate or pyriform, sometime branched, yellow to hyaline, inamyloid, thin- to thick-walled; apical setulae 2-5 × 1 μm, cylindrical, subacute, brown to dark brown, thick-walled. *Pileus trama* interwoven, inamyloid. *Lamellar trama* hyphae 4-6 μm diam., regular to interwoven, cylindrical, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-5 μm diam., parallel, cylindrical, brown to greenish brown, smooth, inamyloid, thin- to thick-walled (up to 0.5 μm), non-gelatinous. *Stipe trama* hyphae 2-5 μm diam., parallel, cylindrical, hyaline, smooth, weakly dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

Habit, habitat and known distribution: Scattered to gregarious on grass leaves, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Mae Taeng District, Street to Pathummigaram

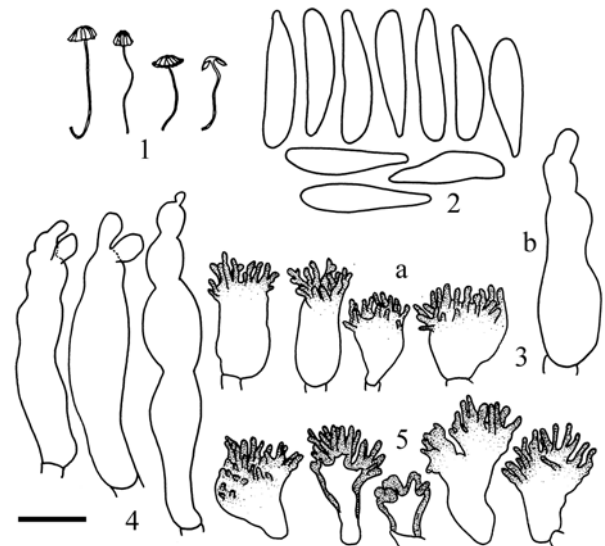


Fig. 64. *Marasmius haematocephalus* “f. *atrobrunneus*” (N. Wannathes 117). 1. Basidiomes 2. Basidiospores 3a. *Siccus*-type cheilocystidia 3b. Non-setulose cheilocystidia 4. Pleurocystidia 5. Pileipellis, Scale bar 1 = 10 mm, 2-5 = 10 μm

temple in Padeng Village, 22 August 2003, N. Wannathes 117 (CMU, SFSU).

Discussion: *Marasmius haematocephalus* “f. *atrobrunneus*” differs from all other forms of this species in forming a smaller (1- 5 mm diam.) dark brown pilei without red, violet, purple or yellowish orange tones.

54C. *Marasmius haematocephalus* “f. *variabilis*” Wannathes, Desjardin & Lumyong, **nom. prov.** (Figs 65, 69-3)

Pileus 5-12 mm diam., convex, sulcate, pruinose, dull, when young olive to greyish blue overall or disc dark purple and margin brownish purple with dark brownish grey to dark olive sulcae, when mature disc dark purple and margin fading to reddish brown or purplish brown with greyish blue sulcae. *Context* brownish grey, thin. *Lamellae* adnexed, subdistant (10-13), narrow to broad (1-2 mm), pinkish cream with or without pinkish brown edges, non-intervenose. *Stipe* 20-32 × 0.5-1 mm, central, cylindrical, wiry, hollow, glabrous, non-insititious, apex purple, base dark brownish purple. *Odor* and *taste* not distinctive.

Basidiospores (17-)19-22(-24) × 3.5-5(-5.5) μm [$x_{mr} = 20.3-21.6 \times 3.9-4.2 \mu\text{m}$, $x_{mm} = 21.0 \pm 0.9 \times 4.1 \pm 0.3 \mu\text{m}$, $Q_{mr} = 5.1-5.3$, $Q_{mm} = 5.2 \pm 0.1$, $n = 25$ spores, $s = 2$ specimens], clavate to fusoid, often curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to

clavate. *Cheilocystidia* composed of 2 types of cells: a) *Siccus*-type broom cells with main body $15\text{-}20 \times 5\text{-}7 \mu\text{m}$, cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae $2\text{-}10 \times 1\text{-}(1.5) \mu\text{m}$, cylindrical, subacute to acute, greenish brown, thick-walled; b) non-setulose cells like the pleurocystidia, $40\text{-}52 \times 7\text{-}8 \mu\text{m}$, fusoid to clavate, usually attenuated and strangulate at the apex, hyaline, inamyloid, thin-walled. *Pleurocystidia* common, $54\text{-}67 \times 10\text{-}12 \mu\text{m}$, clavate to fusoid, usually attenuated and strangulate at the apex, hyaline, inamyloid, thin-walled. *Pileipellis* hymeniform, not mottled, composed of *Siccus*-type broom cells; main body $10\text{-}16 \times 6\text{-}8 \mu\text{m}$, cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin-walled; apical setulae $4\text{-}7 \times 1 \mu\text{m}$, cylindrical, subacute to acute, dark greenish brown, thick-walled. *Pileus trama* interwoven, weakly dextrinoid. *Lamella trama* hyphae $3\text{-}9 \mu\text{m}$ diam., interwoven, cylindrical, smooth, hyaline, weakly dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae $3\text{-}5 \mu\text{m}$ diam., subparallel, cylindrical, brown, smooth, inamyloid to weakly dextrinoid, thin- to thick-walled (up to $1 \mu\text{m}$), non-gelatinous. *Stipe trama* hyphae $3\text{-}6 \mu\text{m}$ diam., parallel, cylindrical, hyaline, smooth, inamyloid to weakly dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous or bamboo leaves, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 25 June 2005, N. Wannathes 336 (CMU, SFSU); Phrae Province, Muang District, Cherg Thong Waterfall, 16 August 2005, N. Wannathes 415 (CMU); Phrae Province, Muang District, Pa Dang, Nong Kam Village, near Nong Kam reservoir, 18 August 2005, N. Wannathes 430 (CMU, SFSU).

Discussion: *Marasmius haematocephalus* “f. *variabilis*” differs from the other forms of *M. haematocephalus* in forming pilei that display the full rainbow of colours found in other forms throughout development, including blue, olive, red, violet, purple and grey. However, “f. *variabilis*” still forms pinkish cream lamellae with or without pinkish brown edges, and a stipe that has a purple apex and dark brownish purple base, colors characteristic of f.

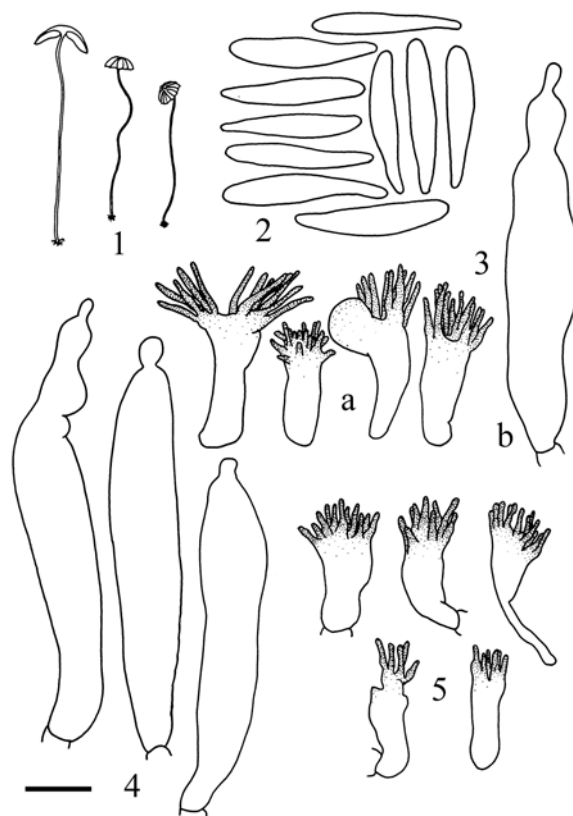


Fig. 65. *Marasmius haematocephalus* “f. *variabilis*” (N. Wannathes 433). 1. Basidiomes 2. Basidiospores 3a. *Siccus*-type cheilocystidia 3b. Non-setulose cheilocystidia 4. Pleurocystidia 5. Pileipellis, Scale bar 1 = 10 mm, 2-5 = 10 μm

haematocephalus.

54D. *Marasmius haematocephalus* “f. *robustus*” Wannathes, Desjardin & Lumyong, **nom. prov.** (Figs 66, 69-2)

Pileus 10-20(-30) mm diam., obtusely conical when young, convex to plano-convex in age, disc rugulose, sulcate to plicate, glabrous, dull, dark reddish brown to dark violet brown (10-11F6-8) when young, fading to reddish-greyish brown to greyish purple in age. **Context** greyish cream, thin. **Lamellae** adnexed, distant to subdistant (9-15), broad (2-4 mm), yellowish grey (2B2) to greyish yellow (4B3), non-marginate or brown-marginate, non-intervenose. **Stipe** 13-43(-62) \times 0.5-1 mm, central, cylindrical, wiry, hollow, glabrous, non-insititious, apex greyish white, base dark brown. **Odor** and **taste** not distinctive.

Basidiospores (16-)18-23(-24) \times (3.5-)4-5(-6) μm [$x_{mr} = 18.5\text{-}21.6 \times 3.9\text{-}4.5 \mu\text{m}$, $x_{mm} = 20.0 \pm 1.3 \times 4.1 \pm 0.1 \mu\text{m}$, $Q_{mr} = 4.2\text{-}5.5$, $Q_{mm} = 4.9 \pm 0.4$, $n = 25$ spores, $s = 9$ specimens],

clavate to fusoid, often curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* composed of 2 types of cells: a) *Siccus*-type broom cells with main body (7-)11-19(-23) × 6-11 μm, cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae 2-6(-10) × 1 μm, cylindrical, subacute to acute, yellow, thin- to thick-walled; b) non-setulose cells like the pleurocystidia, 35-53 × 8-12 μm, fusoid to clavate, usually attenuated and strangulate at the apex, hyaline, inamyloid, thin-walled. *Pleurocystidia* common, 38-62 × 6-15 μm, clavate to fusoid, usually attenuated and strangulate at the apex, hyaline, inamyloid, thin-walled. *Pileipellis* hymeniform, not mottled, composed of *Siccus*-type broom cells; main body 10-28 × 6-13 μm, cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin- to thick-walled; apical setulae 2-5(-7) × 1 μm, cylindrical, subacute to acute, brown to dark brown, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae (2-)4-6(-14) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, weakly dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-9(-12) μm diam., subparallel, cylindrical, brown to dark brown, smooth, weakly dextrinoid, thin- to thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 3-12 μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves or wood, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Sangasabhasri Land on the way to Huai Kok Ma Village, N 18° 48.4' E 98° 54.6' alt. 1,146 m., 29 July 2003, N. Wannathes 053 (CMU, SFSU); same location, 14 August 2003, N. Wannathes 110 and 111, (CMU, SFSU); Chiang Mai Province, Doi Inthanon National Park, Junction of Highway 1,009 and road to Mae Chaem, N 18° 31.6' E 98° 29.6' alt. 1,703 m., 3 July 2004, N. Wannathes 203 (CMU, SFSU); Chiang Rai Province, Muang District, Khun Con Waterfall, 12 June 2005, N. Wannathes 301 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Medicinal Plat Garden, 16 June 2005, N. Wannathes 314 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 25 June 2005, N. Wannathes 330 (CMU, SFSU); Phrae Province,

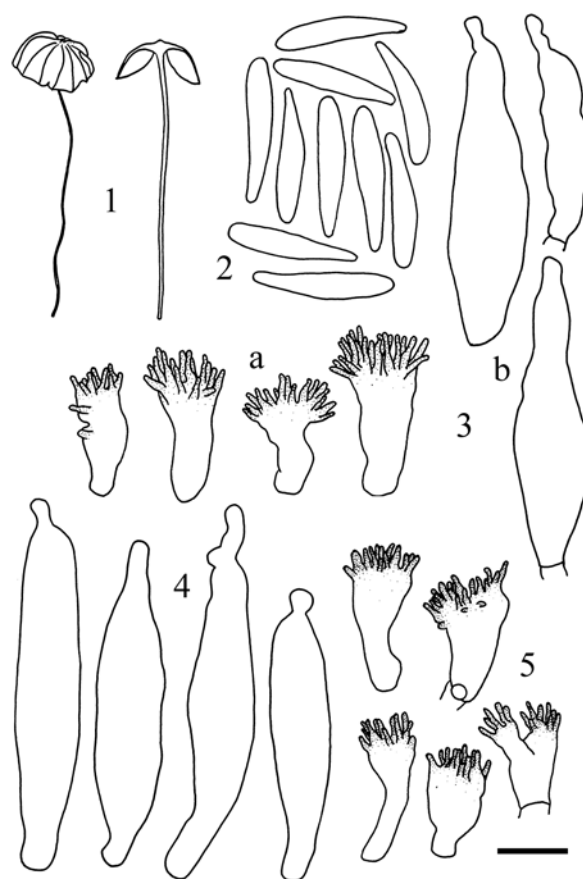


Fig. 66. *Marasmius haematocephalus* “f. *robustus*” (N. Wannathes 433). 1. Basidiomes 2. Basidiospores 3a. *Siccus*-type cheilocystidia 3b. Non-setulose cheilocystidia 4. Pleurocystidia 5. Pileipellis, Scale bar 1 = 10 mm, 2-5 = 10 μm

Muang District, Chergng Thong Waterfall, 16 August 2005, N. Wannathes 417 (CMU, SFSU); same location, 19 August 2005, N. Wannathes 433 (CMU, SFSU).

Discussion: *Marasmius haematocephalus* “f. *robustus*” is unique because of its robust pilei (10-30 mm diam.) and range of pileus colours that are similar to both forms *haematocephalus* and “*violaceus*”. This provisional Thai form is phenetically similar to *M. haematocephalus* var. *macrocephalus* Singer, described from Bolivia, except that the latter grows on monocot leaves (Singer, 1976).

54E. *Marasmius haematocephalus* “f. *violaceus*” Wannathes, Desjardin & Lumyoung, **nom. prov.** (Figs 67, 69-4)

Pileus 4-18 mm diam., obtusely conical to convex, umbonate, sometimes with a rugulose disc, striate to sulcate, pruinose to finely velutinous, dull, dark purple (14F7) to dark magenta (13F7) overall when young, in age disc dark violet to greyish violet (14C4)

and margin pinkish purple to violet. *Context* purplish white (14A3), thin. *Lamellae* adnexed, distant (7-12), narrow to broad (1-2 mm), purplish pink (14A3), non-marginate, non-intervenose. *Stipe* 13-30 × 0.2-0.5 mm, central, cylindrical, wiry, hollow, glabrous, non-insititious, apex purplish white, base dark brown. *Odor* and *taste* not distinctive.

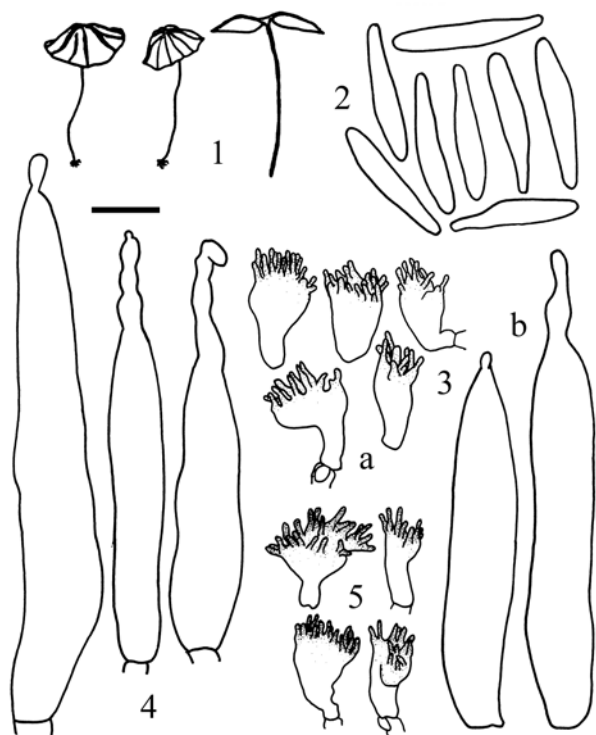


Fig. 67. *Marasmius haematocephalus* “f. *violaceus*” (N. Wannathes 413). 1. Basidiomes 2. Basidiospores 3a. *Siccus*-type cheilocystidia 3b. Non-setulose cheilocystidia 4. Pleurocystidia 5. Pileipellis, Scale bar 1 = 10 mm, 2-5 = 10 μ m

Basidiospores (19-)20-24(-25) × 3.5-5 μ m [x_{mr} = 20.6-21.8 × 3.8-4.2 μ m, x_{mm} = 21.4 ± 0.6 × 4.0 ± 0.1 μ m, Q_{mr} = 5.3-5.5, Q_{mm} = 5.4 ± 0.1, n = 25 spores, s = 4 specimens], clavate to fusoid, often curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid to clavate. *Cheilocystidia* composed of 2 types of cells: a) *Siccus*-type broom cells with main body 10-21 × 5-11 μ m, cylindrical to clavate or irregular in outline, hyaline, inamyloid, thin-walled; apical setulae 2-5(-14) × 1(-2) μ m, cylindrical, subacute to acute, yellow, thin- to thick-walled; b) non-setulose cells like the pleurocystidia, 38-74 × 8-10 μ m, fusoid to clavate, usually attenuated and strangulate at the apex, hyaline,

inamyloid, thin-walled. *Pleurocystidia* common, 38-73 × 7-13 μ m, clavate to fusoid, usually attenuated and strangulate at the apex, hyaline, inamyloid, thin-walled. *Pileipellis* hymeniform, not mottled, composed of *Siccus*-type broom cells; main body 10-17 × 4-10 μ m, cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin- to thick-walled; apical setulae 2-5(-8) × 1 μ m, cylindrical, subacute to acute, brown, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 3-8(-12) μ m diam., interwoven, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 2-6(-8) μ m diam., subparallel, cylindrical, brown, smooth, dextrinoid, thin- to thick-walled (up to 1 μ m), non-gelatinous. *Stipe trama* hyphae 3-8(-10) μ m diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves or on bamboo debris, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Mae Taeng District, New Waterfall, on 36 km. marker of Hwy1095, 2 July 2004, N. Wannathes 193 and 195 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5'E 98° 46.3' alt. 1014 m., 25 June 2005, N. Wannathes 339 (CMU, SFSU); Phrae Province, Muang District, Cherg Thong Waterfall, 16 August 2005, N. Wannathes 413 (CMU, SFSU).

Discussion: This taxon represents the dark violet-purple form commonly encountered in Southeast Asia and reported only as *M. haematocephalus* from Papua New Guinea by Desjardin and Horak (1997). It differs from f. *haematocephalus*, as reported by Desjardin et al. (2000) from Indonesia, in that the latter form has deep reddish brown to maroon pilei (lacking obvious deep purple and violet tones). The provisional Thai form may be identical to *M. haematocephalus* var. *violaceus* Singer, described from Bolivia (Singer, 1976), although we are hesitant to accept Southeast Asian populations as representing a New World taxon without data to support vicariance or recent dispersal.

A bipolar mating system was reported for this form of *M. haematocephalus* by Tan et al. (2007) based on material from Malaysia.

54F. *Marasmius haematocephalus* (Mont.) Fr. f. *haematocephalus* (Figs 68, 69-5)

Pileus 3-10(-14) mm diam., obtusely conical when young, convex with or without a rugulose umbo in age, striate to sulcate, pruinose, dull, disc deep reddish brown to maroon, margin greyish red (11C6) to violet brown (11D7). *Context* pinkish cream, thin. *Lamellae* adnexed, distant (9-14) with 0-1 series of lamellulae, narrow, purplish cream, non-marginate, non-intervenose. *Stipe* 10-40 × < 0.5 mm, central, cylindrical, wiry, hollow, glabrous, non-insititious, apex light violet to light purple, base brown to purplish brown. *Odor* and *taste* not distinctive.

Basidiospores (15-)17-20(-25) × (3-)4-5 μm [$x_{mr} = 16.8-21.9 \times 4.0-4.3 \mu m$, $x_{mm} = 18.4 \pm 1.9 \times 4.0 \pm 0.1 \mu m$, $Q_{mr} = 3.9-4.7$, $Q_{mm} = 4.6 \pm 0.5$, $n = 25$ spores, $s = 6$ specimens], clavate to narrowly fusoid, often curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* 23-25 × 5-6 μm, cylindrical to clavate, 4-spored. *Basidioles* fusoid to clavate. *Cheilocystidia* composed of 2 types of cells: a) *Siccus*-type broom cells with main body 8-17 × 5-11 μm, cylindrical to clavate, or pyriform, often branched, hyaline, inamyloid, thin-walled; apical setulae 1-4(-5) × 1 μm, cylindrical, subacute, yellow to brownish yellow, thin- to thick-walled; b) non-setulose cells like the pleurocystidia, 25-41 × 7-12 μm, fusoid to clavate, usually attenuated and strangulate at the apex, often with 2-4 successive apical constrictions, hyaline inamyloid, thin-walled. *Pleurocystidia* common, 32-54 × 6-12(-15) μm, clavate to fusoid, usually attenuated and strangulate at the apex, sometimes with 2 successive apical constrictions, hyaline, inamyloid, thin-walled. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body (6-)8-20 × 5-12 μm, clavate to broadly clavate or pyriform, sometimes branched, yellow to hyaline, inamyloid, thin- to thick-walled; apical setulae 2-5 × 1(-1.5) μm, cylindrical, subacute, brown to dark brown, thick-walled. *Pileus trama* interwoven, weakly dextrinoid to dextrinoid. *Lamellar trama* hyphae 3-7(-12) μm diam., interwoven, cylindrical to inflated, smooth, hyaline, weakly dextrinoid to dextrinoid, thin-walled, non-

gelatinous. *Stipitipellis* hyphae 3-7 μm diam., parallel, cylindrical, brown to greenish brown, smooth, dextrinoid, thin- to thick-walled (up to 1 μm), non-gelatinous. *Stipe trama* hyphae 3-5(-7) μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

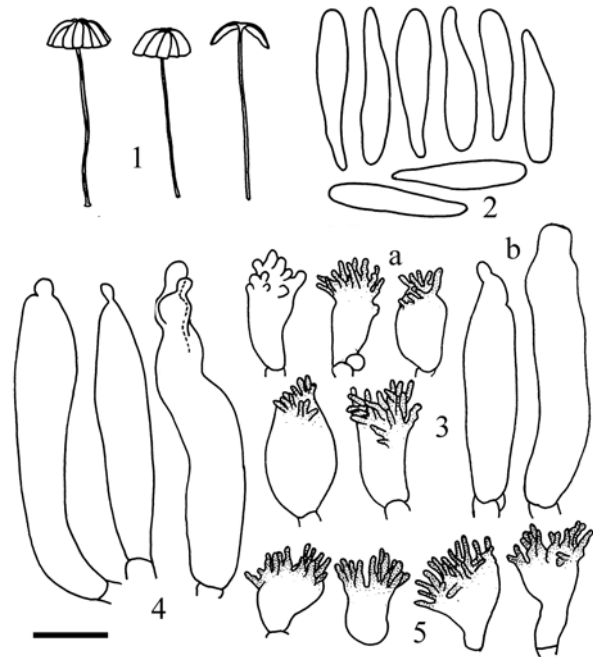


Fig. 68. *Marasmius haematocephalus* f. *haematocephalus* (N. Wannathes 428). 1. Basidiomes 2. Basidiospores 3a. *Siccus*-type cheilocystidia 3b. Non-setulose cheilocystidia 4. Pleurocystidia 5. Pileipellis, Scale bar 1 = 10 mm, 2-5 = 10 μm

Habit, habitat and known distribution. Scattered to gregarious on dicotyledonous leaves, Africa, neotropics, Java, Malaysia, Papua New Guinea, Sri Lanka and Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Mokfa Waterfall, on Hwy 1095, N19° 6.5' E 98° 46.3' alt. 1014 m., 29 June 2004, Y.S. Tan 277 (CMU, SFSU); Chiang Rai Province, Muang District, Horticulture Research Center, 12 June 2005, N. Wannathes 296 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Medicinal Plant Garden, 16 June 2005, N. Wannathes 316 (CMU, SFSU); Phrae Province, Muang District, Suen Keun, Na Koo Haa Waterfall, 15 August 2005, N. Wannathes 409 (CMU, SFSU); Phrae Province, Muang District, Chergng Thong Waterfall, 16 August 2005, N. Wannathes 418 (CMU, SFSU), same location, 19 August 2005, N. Wannathes 434 (CMU, SFSU); Phrae Province, Muang District, Pa Dang, Nong Kam Village, near Nong Kam reservoir, 18 August 2005, N. Wannathes 428 (CMU, SFSU).

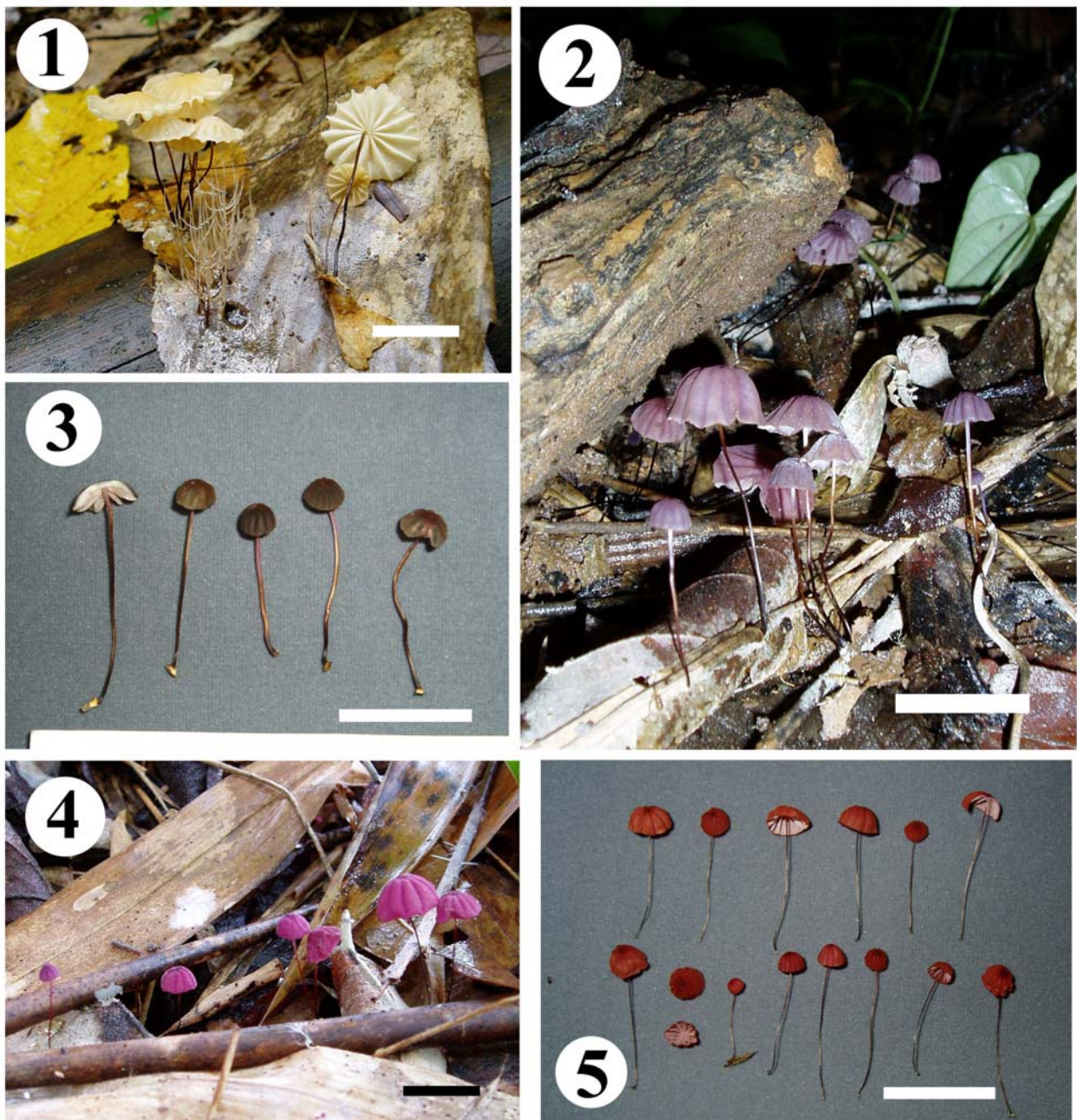


Fig. 69. Basidiomata of forms of *Marasmius haematocephalus*. 1. *M. haematocephalus* “f. *luteocephalus*” (N.Wannathes 310) 2. *M. haematocephalus* “f. *robustus*” (N.Wannathes 433) 3. *M. haematocephalus* “f. *variabilis*” (N.Wannathes 430) 4. *M. haematocephalus* “f. *violaceus*” (N.Wannathes 413) 5. *M. haematocephalus* f. *haematocephalus* (N.Wannathes 428), Scale bars = 20 mm.

Discussion: *Marasmius haematocephalus*, a commonly reported pantropical species, is characterized by a small (3-14 mm diam.), obtusely conical to convex, striate to sulcate pileus coloured deep reddish brown to maroon, distant (9-14), narrow, pink or purplish cream lamellae, a wiry, non-insititious, glabrous stipe with light violet to purple apex and brown base, clavate basidiospores with mean range $16.8-21.9 \times 4.0-4.3 \mu\text{m}$, numerous strangulate

pleurocystidia, and an absence of caulocystidia. Singer (1976) recognized nine distinct varieties of this species occurring in the New World tropics distinguished mainly by pileus pigmentation. As indicated above, we can distinguish six distinct forms in Thailand, some of which are nearly indistinguishable from the varieties reported by Singer (1976) from the neotropics. Until molecular data from neotropical populations are compared with

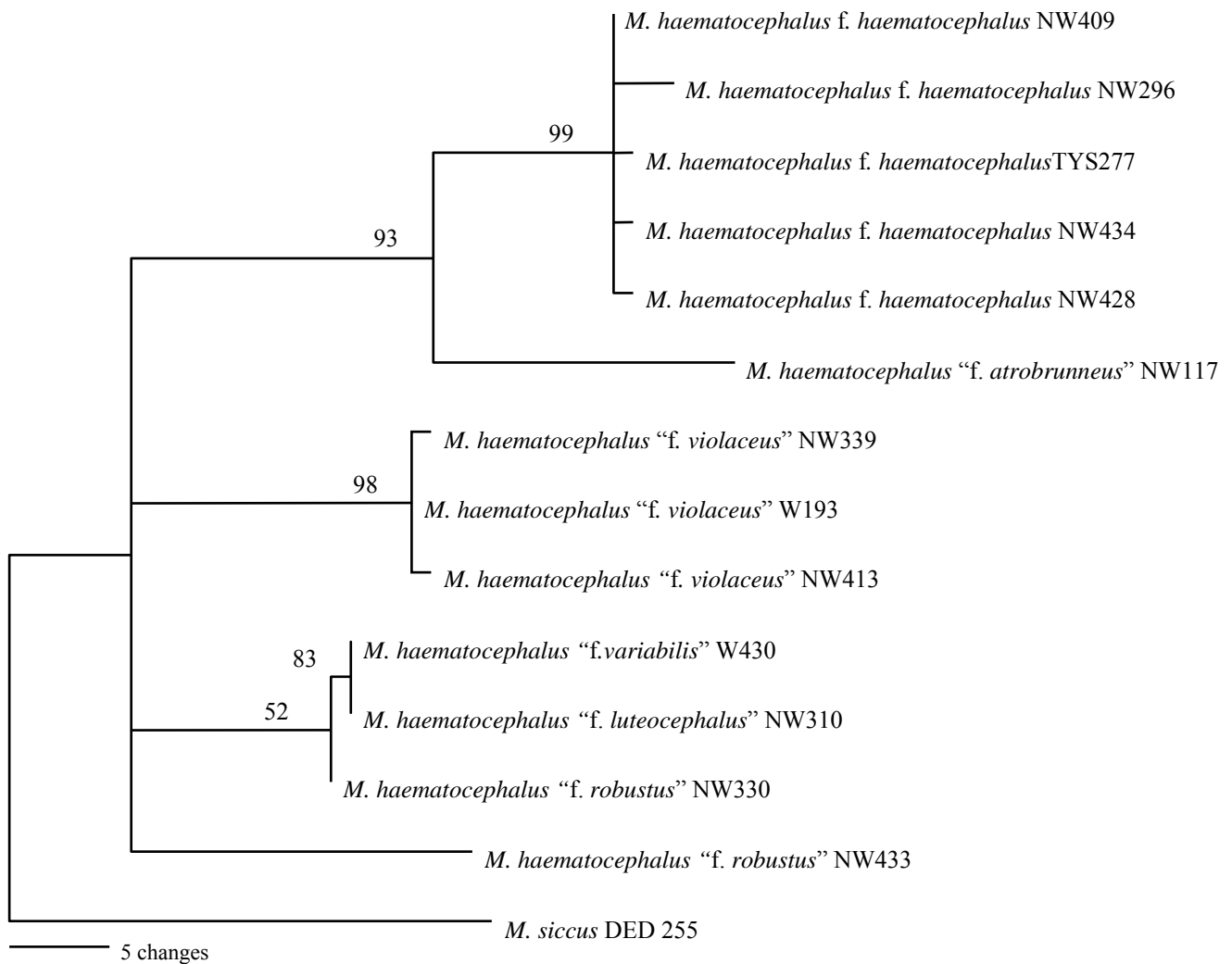


Fig. 70. Branch and bound bootstrap tree of *Marasmius haematocephalus* species complex. Numbers above branches represent support from 2000 bootstrap replicates.

those of the Thai populations, we hesitate to designate the Thai material with Singer's epithets.

In the ML tree, 13 sequences of the macromorphologically distinct yet micromorphologically indistinguishable *M. haematocephalus* formed a clade (AE) with strong support (1.0 PP, 99% BS) and some internal phylogenetic structure. A bootstrap branch and bound analysis of 2000 replicates of a dataset including all 13 *M. haematocephalus* sequences with *M. siccus* as outgroup (Fig. 70), recognized most of the macromorphological entities as distinct clades. Representative sequences conforming to forma *haematocephalus* formed a clade with 99% BS support; those of "f. *violaceus*" formed a clade with 98% BS support; "f. *variabilis*" and "f. *luteocephalus*" showed invariable sequences

and were sister taxa with 83% BS support; whereas "f. *robustus*" was unresolved.

55. *Marasmius hypophaeus* Berk & M.A. Curtis, J. Linn. Soc., Bot. 10: 298. 1868.

(Figs 71, 75-1)

Pileus 2-8 mm diam., paraboloid to convex, disc rugulose, striate, pruinose, dull, brown (7D8) to ferruginous when young, greyish orange (6B4) in age. *Context* cream, thin. *Lamellae* free to adnexed, distant (11-13), narrow, cream with brownish orange edges, non-intervenose. *Stipe* 23-35 × < 0.5 mm, central, cylindrical, wiry, glabrous, insititious to non-insititious, apex yellowish white, base dark brown. *Odor* and *taste* not distinctive.

Basidiospores 16-18 × 4 μm [x = 17.2 ± 0.7 × 4.0 ± 0 μm, Q = 4.0-4.5, Q_m = 4.2, n = 25 spores, s = 1 specimen], narrowly ellipsoid to

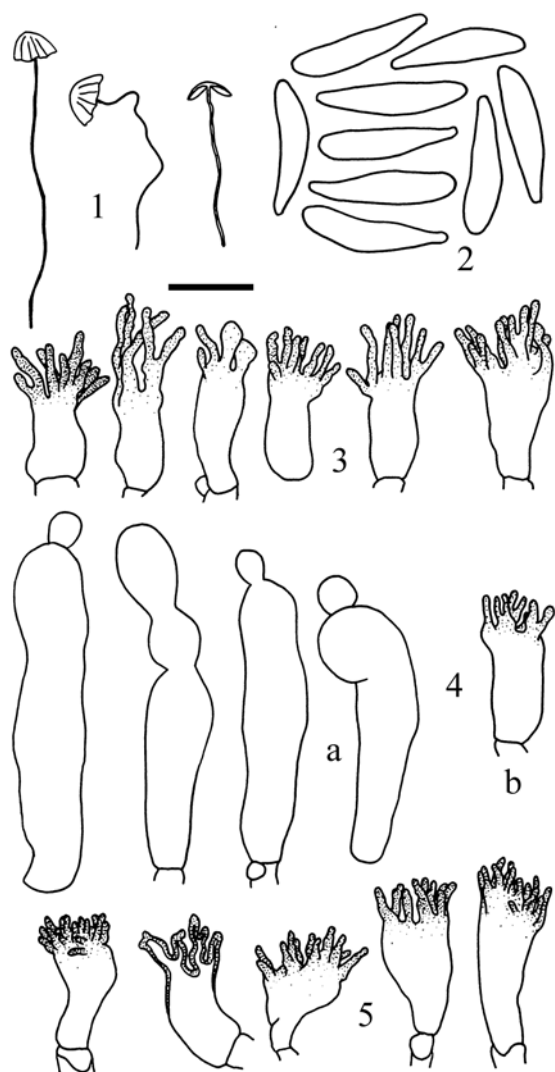


Fig. 71. *Marasmius hypophaeus* (N. Wannathes 285). 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4a. Non-setulose cheilocystidia 4b. *Siccus*-type pleurocystidia 5. Pileipellis, Scale bar 1 = 20 mm, 2-5 = 10 μ m

fusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* cylindrical to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 10-15 \times 6-8 μ m, cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae 5-11 \times 1(-3) μ m, cylindrical, wavy, often forked, conical to subacute, yellow to brownish yellow, thin- to thick-walled. *Pleurocystidia* composed of 2 type of cells: a) rarely present, *Siccus* broom cells with main body 13-15 \times 4-6 μ m, cylindrical, hyaline, inamyloid, thin-walled; apical setulae 3-5 \times 1 μ m, cylindrical, conical to subacute, hyaline, thick-walled; b) non-setulose cells, common, 41-48 \times 7-9 μ m, cylindrical to clavate, strangulate at the apex, hyaline, inamyloid, thin-walled. *Pileipellis*

hymeniform, weakly mottled, composed of *Siccus*-type broom cells; main body 11-19 \times 7-9 μ m, cylindrical to clavate, pale yellow, inamyloid, thin-walled; apical setulae 2-5 \times 1-1.5 μ m, crowded, cylindrical, often wavy, subacute, brownish yellow to light brown, thin- to thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae (3-)-4-7(-10) μ m diam., interwoven, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-4 μ m diam., subparallel, cylindrical, yellowish brown to light brown, smooth, weakly dextrinoid, thin-walled, non-gelatinous. *Stipe trama* hyphae 3-7 μ m diam., parallel, cylindrical, hyaline, smooth, weak dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on monocotyledonous or dicotyledonous leaves, Cuba, Java and Northern Thailand.

Material examined: Thailand. Chiang Rai Province, Khun Chae National Park, N 19° 4.4' E 99° 23.5' alt. 963 m., 10 June 2005, N. Wannathes 285 (CMU, SFSU)

Discussion: *Marasmius hypophaeus* is characterized by a small, striate pileus coloured ferruginous to greyish orange, distant lamellae, colored cream lamellae with brownish orange edges, basidiospores with mean 17.2 \times 4.0 μ m, and growth on both monocotyledonous and dicotyledonous leaves. Described originally from Cuba, this is the second report of the species from the Old World tropics. Desjardin *et al.* (2000) reported the species from Java.

56. *Marasmius* aff. *pallescens* Murrill, N. Amer. Fl. 9(4): 261. 1915. (Figs 72, 75-2)

Pileus 4-15 mm diam., obtusely conical to convex, sometimes with a small papilla when young, broadly conical with rugulose disc in age, sulcate, pruinose, dull, light brown (7D5-6) to pale greyish brown (7D3-4) when young, grey to greyish orange (6B-C3) in age. *Context* light brownish cream, thin. *Lamellae* adnexed, subdistant (12-16), broad (1-3 mm), light brownish cream, non-marginate, non-intervenose. *Stipe* 20-50 \times 0.5-0.8 mm, central, cylindrical, wiry, glabrous, non-insititious, apex yellowish white, base dark brown. *Odor* and *taste* not distinctive.

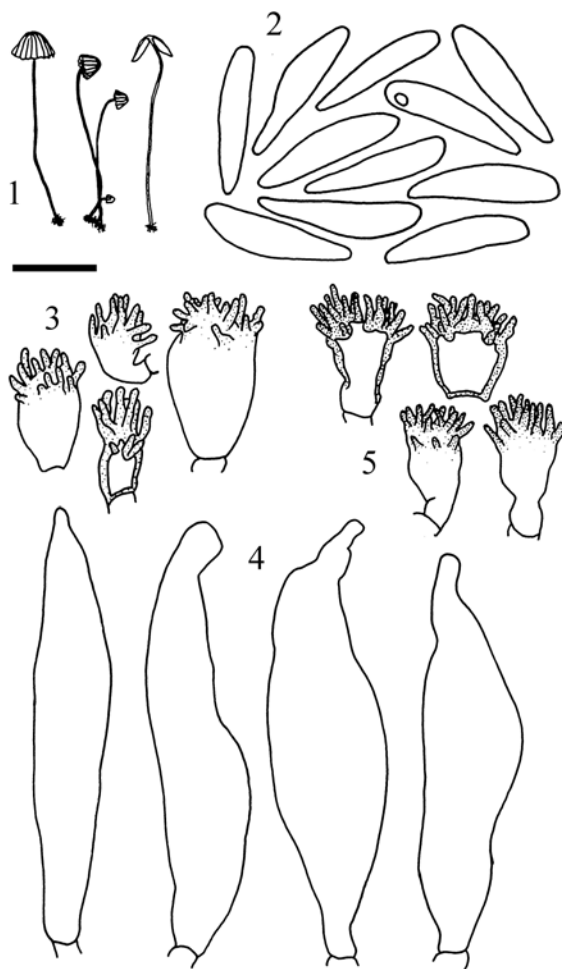


Fig. 72. *Marasmius* aff. *pallescens* (N. Wannathes 424). 1. Basidiomes 2. Basidiospores 3. Cheilocystidia 4. Pleurocystidia 5. Pileipellis, Scale bar 1 = 20 mm, 2-5 = 10 μ m

Basidiospores (16-)17-18(-19) \times 4-5 μ m [$x = 17.5 \pm 0.7 \times 4.1 \pm 0.3 \mu$ m, $Q = 3.6-4.8$, $Q_m = 4.3$, $n = 25$ spores per 1 specimen], narrowly ellipsoid to fusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* cylindrical to clavate. *Cheilocystidia* common, of *Siccus*-type broom cells; main body 6-18 \times 5-10 μ m, cylindrical to clavate, hyaline, inamyloid, thin- to thick-walled; apical setulae 3-6 \times 1 μ m, cylindrical, conical to subacute, yellow to pale yellow, thick-walled. *Pleurocystidia* common, 46-53 \times 10-15 μ m, cylindrical to fusoid, constricted at the apex, hyaline, inamyloid, thin-walled. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body 9-17 \times 6-8 μ m, cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae 3-5 \times 1 μ m, crowded, cylindrical, subacute, brownish yellow to light brown, thick-walled. *Pileus trama* interwoven, dextrinoid. *Lamellar trama* hyphae 3-8(-10)

μ m diam., interwoven, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-5 μ m diam., parallel, cylindrical, brown, smooth, dextrinoid, thick-walled (up to 1 μ m), non-gelatinous. *Stipe trama* hyphae 3-5 μ m diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

Habit, habitat and known distribution: Scattered to gregarious on dicotyledonous leaves or on wood, Northern Thailand.

Material examined: Thailand. Phrae Province, Muang District, Pa Dang, Nong Kam Village, near Nong Kam reservoir, 18 August 2005, N. Wannathes 424 (CMU, SFSU)

Discussion: The Thai specimen is similar to *M. pallescens* Murr. as reported by Pegler (1983) from the Lesser Antilles in all taxonomically significant details except for Pegler's report of slightly smaller basidiospores (12-17.5 \times 3-5 μ m, $x = 14.5 \times 3.8 \mu$ m). Because *M. pallescens* is currently known only from the neotropics, until further material is collected in Thailand, sequenced, and compared with neotropical specimens, our identification must remain tentative.

57. *Marasmius bondoi* Wannathes, Desjardin & Lumyong, **sp. nov.** (Figs 73, 75-3)
Mycobank: MB512430

Etymology: 'bondoi' (Thai) = on the mountain; referring to the habitat where the holotype specimen was found.

Pileus 12-32 mm diametro, convexus usque plano-convexus, umbonatus vel subumbonatus, striatus usque sulcatus, pruinosis, hebetatus, disco atrobrunneo usque brunneo, margine flavo-brunneo, hygrophanus, ubique pallide brunneo-flavo post arescendum. *Contextus* flavo-brunneus, tenuis. *Lamellae* annexae usque liberae, distantes usque subdistantes (10-20) cum 2-4 seriebus lamellarum, latae (2-4 mm), cinereo-aurantiaca, haud marginatae, haud intervenosae. *Stipes* 32-92 \times 1-2 mm, centralis, cylindratus, filo metallico similis, cavus, glaber, haud insititius, apice cinereo-flavo, basi rubro-brunnea usque violaceo-brunnea. *Odor* suco cocois similis. *Sapor* non proprius. *Basidiosporae* 13-18(-20) \times 3-5 μ m, anguste ellipsoideae usque fusoideae, oblique curvae, laeves, hyalinae, inamyloideae, tenuitunicatae *Basidia* 25-29 \times 7-9 μ m, cylindrata usque clavata, 4-spora. *Basidiolae* fusoideae usque clavatae. *Cheilocystidia* abundantia, typi *Sicci*; (7-)12-21 \times (3-)5-10 μ m, cylindrata usque clavata, hyalina, inamyloidea, tenuitunicata; setulis apicalibus 3-15(-21) \times 1-2 μ m, cylindratis usque conicis, interdum lobatis, subacutis, flavis usque pallide flavis, tenuitunicatis. *Pleurocystidia* vulgaria, 40-58 \times 7-15 μ m, cylindrata usque fusoidea,

constricta et interdum lobata ad apicem, hyalina, inamyloidea, tenuitunicata. *Pileipellis* hymeniformis, maculosus, typi *Sicci*; (8-)13-20(-25) × 6-10 μm, cylindricus usque clavatus vel pyriformis, hyalinus usque pallide flavus, inamyloideus, tenui- usque crassetunicatus; setulis apicalibus 4-10(-15) × 1-1.5 μm, coartatis, cylindricis, subacutis, flavo-brunneis usque brunneis, crassetunicatis. *Trama pilei* intertexta, hyphis 3-8 μm diametro, cylindricis usque inflatis, laevibus, hyalinis, fortiter dextrinoideis, tenuitunicatis. *Trama lamellae* intertexta usque regularis, hyphis 3-8(-13) μm diametro, cylindricis usque inflatis, laevibus, hyalinis, dextrinoideis, tenuitunicatis, haud gelatinosis. *Stipitipellis* subparallelus, hyphis 3-6(-9) μm diametro, cylindricis, flavo-brunneis usque brunneis, laevibus, leniter dextrinoideis, crassetunicatis (usque ad 2 μm), haud gelatinosis. *Trama stipitis* parallela, hyphis 4-13(-19) μm diametro, cylindricis, hyalinis, laevibus, dextrinoideis, tenuitunicatis, haud gelatinosis. *Caulocystidia* nulla. *Fibulae* praesentes in omnibus texturis.

Typus: Chiang Mai Province, Doi Suthep-Pui National Park, trail opposite with the way to Huai Kok Ma Village, gregarius usque confertim gregarius, typice caespitosus in ligno vel folis plantae dicotyledoneae, 2 July 2005, N. Wannathes 386 (CMU: **holotypus**; SFSU: **isotypus**).

Pileus 12-32 mm diam., convex to plano-convex, umbonate or subumbonate, striate to sulcate, pruinose, dull, disc dark brown to brown, margin yellowish brown, hygrophalous, fading to pale brownish yellow overall with moisture loss. *Context* yellowish brown (5D5), thin. *Lamellae* adnexed to free, distant to subdistant (10-20) with 2-4 series of lamellulae, broad (2-4 mm), greyish orange, non-marginate, non-intervenose. *Stipe* 32-92 × 1-2 mm, central, cylindrical, wiry, hollow, glabrous, non-insititious, apex greyish yellow (4B4), base reddish brown (8E8) to violet brown (10F8). *Odor* of coconut juice. *Taste* not distinctive.

Basidiospores 13-18(-20) × 3-5 μm [$x_{mr} = 14.2-18.3 \times 3.5-4.6 \mu m$, $x_{mm} = 16.4 \pm 1.3 \times 3.9 \pm 0.3 \mu m$, $Q_{mr} = 3.5-4.9$, $Q_{mm} = 4.2 \pm 0.5$, $n = 25$ spores, $s = 10$ specimens], narrowly ellipsoid to fusoid, curved in profile, smooth, hyaline, inamyloid, thin-walled. *Basidia* 25-29 × 7-9 μm, cylindrical to clavate, 4-spored. *Basidioles* fusoid to clavate. *Cheilocystidia* abundant, of *Siccus*-type broom cells; main body (7-)12-21 × (3-)5-10 μm, cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae 3-15(-21) × 1-2 μm, cylindrical to conical, sometimes lobed, subacute, yellow to pale yellow, thin-walled. *Pleurocystidia* common, 40-58 × 7-15

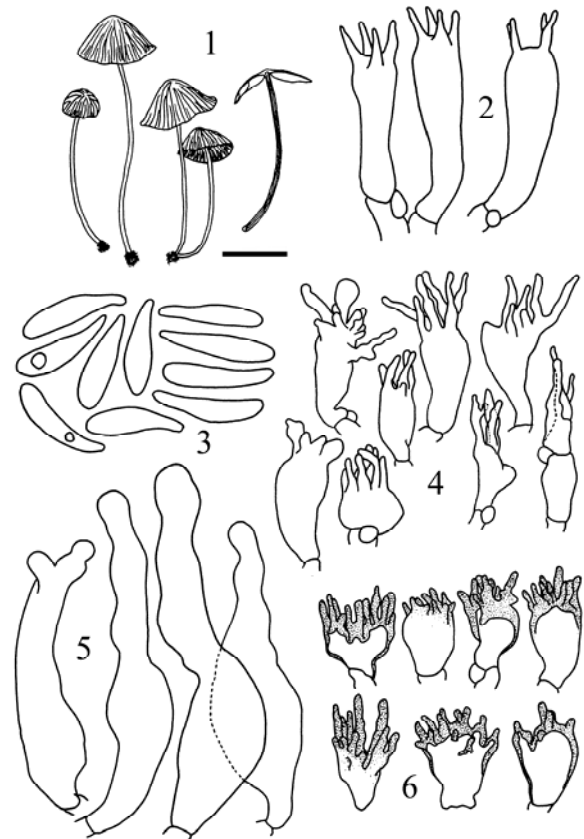


Fig. 73. *Marasmius bondoi* (N. Wannathes 237). 1. Basidiomes 2. Basidia 3. Basidiospores 4. Cheilocystidia 5. Pleurocystidia 6. Pileipellis, Scale bar 1 = 20 mm, 2-6 = 10 μm

μm, cylindrical to fusoid, constricted and sometimes lobed at the apex, hyaline, inamyloid, thin-walled. *Pileipellis* hymeniform, mottled, composed of *Siccus*-type broom cells; main body (8-) 13-20(-25) × 6-10 μm, cylindrical to clavate or pyriform, hyaline to pale yellow, inamyloid, thin- to thick-walled; apical setulae 4-10(-15) × 1-1.5 μm, crowded, cylindrical, subacute, yellowish brown to brown, thick-walled. *Pileus trama* hyphae 3-8 μm diam., interwoven, cylindrical to inflated, smooth, hyaline, strongly dextrinoid, thin-walled. *Lamellar trama* hyphae 3-8(-13) μm diam., interwoven to regular, cylindrical to inflated, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipitipellis* hyphae 3-6(-9) μm diam., subparallel, cylindrical, yellowish brown to brown, smooth, weakly dextrinoid, thick-walled (up to 2 μm), non-gelatinous. *Stipe trama* hyphae 4-13(-19) μm diam., parallel, cylindrical, hyaline, smooth, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present in all tissues.

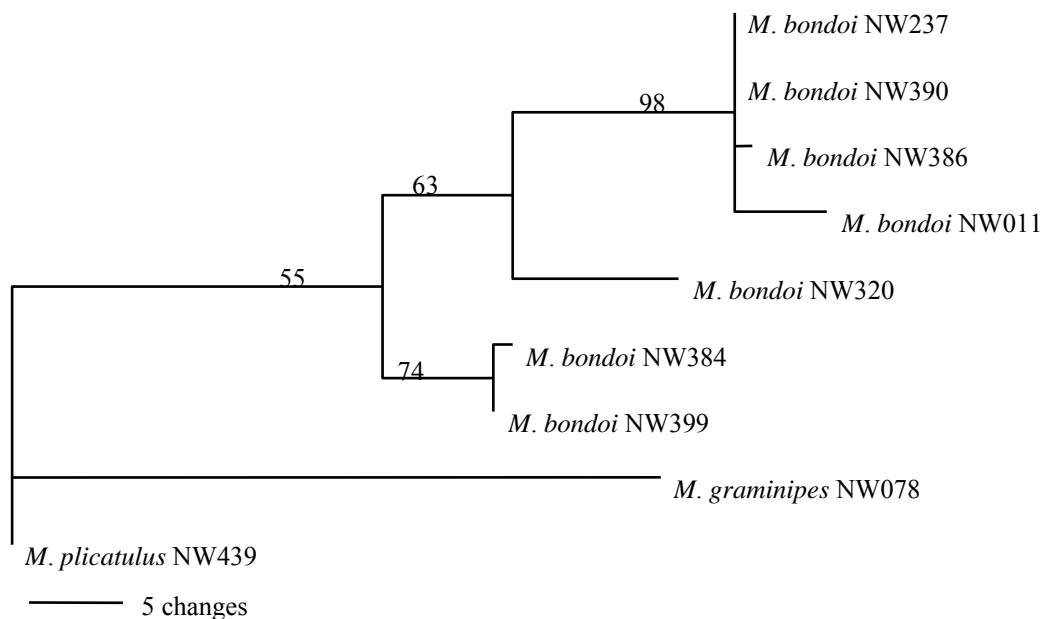


Fig. 74. Branch and bound bootstrap tree of the *Marasmius bondoi* species complex. Numbers above branches represent support from 2000 bootstrap replicates.

Habit, habitat and known distribution.

Gregarious to densely gregarious, typically in cespitose clusters on wood or on dicotyledonous leaves, Northern Thailand.

Material examined: Thailand. Chiang Mai Province, Doi Suthep-Pui National Park, Sangasabhasri Land on the way to Huai Kok Ma Village, N 18° 48.4' E 98° 54.6' alt. 1,146 m., 30 June 2003, N. Wannathes 011 (CMU, SFSU); same location, 6 June 2004, Y.S. Tan 318 (CMU, SFSU); same location, 24 July 2004, N. Wannathes 237 (CMU, SFSU); same location, 24 June 2005, N. Wannathes 320 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, trail opposite with the way to Huai Kok Ma Village, 2 July 2005, N. Wannathes 384 (CMU, SFSU); same location, 2 July 2005, N. Wannathes 386 (CMU: **holotype**; SFSU: **isotype**), N. Wannathes 388, 389 and 390 (CMU, SFSU); Chiang Mai Province, Doi Suthep-Pui National Park, Medicinal Plant Garden, 3 August 2005, N. Wannathes 399 (CMU, SFSU).

Discussion: *Marasmius bondoi* is characterized by a convex, subumbonate, sulcate pileus with brown and yellowish brown tones, distant to subdistant (10-20) lamellae with or without brown edges, basidiospores with means in the range 14.2-18.3 × 3.5-4.6 μm, *Siccus*-type broom cells with setulae 2-15 × 1-2 μm, fusoid-constricted pleurocystidia, and growth on wood or dicot leaf substrates. In a separate branch and bound analysis involving only *M. bondoi* and *M. graminipes* with *M. plicatulus* as outgroup (Fig. 74), several clades

were recognized that differed in lamellar spacing, albeit with low BS support, viz., specimens with distant (10-15) lamellae [NW011, 237, 386 and 390] and specimens with subdistant (13-20) lamellae [NW320, 384 and 399]. All other taxonomically significant micro- and macromorphological features of all *M. bondoi* specimens are overlapping and we recognize them as representing a single species with variable lamellar spacing.

Marasmius bondoi is most phenetically similar to two African species, *M. grandisetulosus* Singer and *M. tenuisetulosus* (Singer) Singer. Both of the latter species are reported to have distinctly striped pilei with darker sulcae (brown or rusty-tawny) and paler ridges (yellowish grey to orange or tawny). The Thai *M. bondoi* has an evenly pigmented pileus that is never striped.

In the ML tree, clade AB contained seven sequences of *M. bondoi* with *M. graminipes* on a relatively long branch embedded within the clade as sister to one sample (NW 390) but with low support (0.52 PP, 53% BS). In a branch and bound analysis with 2000 replicates and *M. plicatulus* as outgroup (Fig. 74), the seven *M. bondoi* sequences cluster with low BS support (55%) and the morphologically distinct *M. graminipes* is sister to the *M. bondoi* clade.



Fig. 75. Basidiomata of *Marasmius* section *Sicci* ser. *Haematocephali* 1. *M. hypopheus* (N. Wannathes 285) 2. *M. aff. pallescens* (N. Wannathes 424) 3. *M. bondoi* (N. Wannathes 237), Scale bars = 20 mm.

Discussion

In most cases, the ITS sequence data supported recognition of morphospecies with high statistical support. For example, three specimens of the new species *M. jasminodorus* (in clade AA, Fig. 1) that were collected in diverse geographical sites (different mountains at different elevations and forest types in different provinces) formed a clade with 0.98 PP and 100% BS support and showed almost no genetic variability.

Singer (1976) recognized *Marasmius* as representing 11 sections. Based on nLSU rDNA sequences data, Wilson and Desjardin (2005) restricted the genus *Marasmius* to only seven sections (viz. *Globulares*, *Hygrometrici*, *Leveilleani*, *Marasmius*, *Neosessiles*, *Scotophysini*, *Sicci*) and recognized the other four Singerian sections (viz., *Alliacei*, *Androsacei*, *Epiphylli*, *Fusicystides*) as belonging to other genera. Only five of the sections in *Marasmius sensu stricto* were encountered in northern Thailand (*Hygrometrici* and *Scotophysini* excluded) and of these, only sect. *Marasmius* subsect. *Marasmius* was monophyletic based on the ITS dataset (Fig. 1; clade D). In addition, Singer

(1976, 1986) and Antonín and Noordeloos (1993) subdivided sect. *Sicci* into four series (viz., *Atrorubentes*, *Haematocephali*, *Leonini*, *Spinulosi*) based on the presence or absence of pleurocystidia, setae or simple cylindrical caulocystidia. None of these series are monophyletic in our analyses. There was very limited statistical support for the deeper nodes in the ML or MP analyses (Fig. 1) suggesting that the ITS region may be of limited value in clarifying the infrageneric delimitation of *Marasmius*. Before any formal reorganization of taxa within *Marasmius* is proposed, further phylogenetic analyses based on a global sample set and additional genes (LSU, *rpb2*, *ef1- α*) must be conducted.

Although the ITS data alone are of limited use in elucidating infrageneric phylogenetic structure, they are very useful in aiding taxonomic delimitations at the species rank. In most cases, species delimitations based on morphological characters are concordant with those suggested by ITS sequence similarity. And this pattern holds true for geographically distant and ecologically distinct populations [cf., *M. jasminodorus* (.98 PP, 100% BS), *M. brunneoolivascens* (.99 PP, 92%

BS), *M. bambusiniiformis* (1.0 PP, 100% BS), *M. laticlavatus* (1.0 PP, 100% BS), *M. cafeyen* (1.0 PP, 100% BS)].

Historically, morphological characters have been used in combination to delimit sections (collariate lamellae, insititious stipe, pileipellis anatomy), series (pleurocystidia, setae or simple caulocystidia), and species (basidiospore size, broom cell setulae, cystidia shape). The ITS data support the use of these morphological characters to aid in delimiting taxa at various taxonomic ranks, albeit not necessarily as circumscribed by Singer (1976, 1986), Antonín and Noordeloos (1993), Desjardin and Horak (1997), and Desjardin *et al.* (2000). For example, all taxa that lack collariate lamellae belong in clades A and F (Fig. 1) and are phylogenetically distinct from taxa with collariate lamellae (all other clades). However, all collariate species (sect. *Marasmius*) do not form a monophyletic group. In addition, all species with non-insititious stipes belong to the well-supported clade A (sects. *Sicci* and *Globulares*), whereas those with insititious stipes belong in the other clades. Moreover, all tested species with a unifactorial (bipolar) mating system belong in clade A, whereas those with a bifactorial (tetrapolar) mating system belong to the clades with collariate lamellae and insititious stipes. Based on these data, clade A, representing all included species of sects. *Sicci* and *Globulares* can be distinguished from all other *Marasmius* by the presence of a non-insititious stipe, bipolar mating system and absence of collariate lamellae. A pileipellis formed from *Siccus*-type broom cells versus *Globulares*-type cells (non-setulose) that currently differentiates sect. *Sicci* from sect. *Globulares* is not a phylogenetically significant feature according to the ITS data. Of the eight species with *Globulares*-type pileipellis elements included in the analyses, five belong to clade AD, one in clade AA, and two are in clade AF. Desjardin and Horak (1997) suggested that the separation of species into sections *Sicci* and *Globulares* based on pileipellis anatomy was untenable when they described *M. nexus* Desjardin & Horak, a species from Papua New Guinea with a pileipellis formed from equal numbers of *Siccus*-type cells and *Globulares*-type cells.

The presence or absence of pleurocystidia, setae or simple caulocystidia have been used to distinguish series with sect. *Sicci*, although these infrageneric groups are not monophyletic based on the ITS data

Likewise, basidiospore size is a taxonomically significant feature to aid in delimiting species, but is of limited use at higher taxonomic levels. For example, *M. pellucidus*, with $x_{\text{mm}} = 7.2 \times 3.3 \mu\text{m}$, belongs to a subclade within clade AA (with .77 PP, 78% BS) and is distinct from the other members (*M. araucariae*, *M. jasminodorus*, *M. inthanonensis*) who have basidiospore means in the range $10.1\text{-}10.4 \times 3.6\text{-}3.9 \mu\text{m}$. Alternatively, shared basidiospore size may be a clade-defining feature. Clade AC, with two setoid (SS) species (*M. nummularius*, *M. trichotus*) and two non-setoid species with simple caulocystidia (SA; *M. iras*, *M. xestocephalus*) all share narrowly fusoid basidiospores with means in the range $12.1\text{-}13.2 \times 3.7\text{-}4.1 \mu\text{m}$.

Combinations of these micro-characters and ITS data can be used to define clades. For example, four species within clade AD with 1.0 PP and 100% BS are circumscribed by *Globulares*-type pileipellis cells, long-clavate basidiospores with means in the range $22.8\text{-}30.0 \times 4.4\text{-}5.6 \mu\text{m}$, and an absence of pleurocystidia and caulocystidia. The ITS data are a tremendous help in delimiting the pleurocystidiate species *M. haematocephalus* (clade AE with 1.0 PP, 99% BS) from other taxa, and in distinguishing its various forms whose pilei range in color from yellowish orange to brown, olive, greyish blue, red and violet. Micromorphologically all isolates of this clade are indistinguishable; however, the branch and bound analysis (Fig. 70) clearly distinguishes five of the six forms into well-supported lineages.

Conclusions

The ITS sequence data generally support the recognition of species circumscribed by macro- and micromorphological characters, and in many cases can be used to delimit clades of taxa with shared morphological features. However, ITS sequences are of limited use in recognizing currently delimited infrageneric

taxa at the series rank and above. Additional species and genes need to be sequenced and analyzed with multiple algorithms in order to clarify the infrageneric delimitation of the genus *Marasmius*

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