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## *Marasmius sensu stricto* in Peninsular Malaysia

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A total of 43 species of *Marasmius sensu stricto* belonging to six sections (*Globulares*, *Hygrometrici*, *Leveilleani*, *Marasmius*, *Neosessiles* and *Sicci*) are reported from Peninsular Malaysia. Macro- and micromorphological characters in combination with ITS sequence data were used to circumscribe species. Of the 43 species reported herein, 9 represent new species, viz., *M. angustilamellatus*, *M. diminutivus*, *M. distantifolius*, *M. iras*, *M. kanchingensis*, *M. kuthubutheenii*, *M. musicolor*, *M. ochropoides*, and *M. olivascens*. An additional 19 species are new records for Peninsular Malaysia. Phylogenetic analyses of 36 Malaysian *Marasmius* species were conducted based on sequence data from nrDNA ITS-1–5.8S–ITS-2 gene regions. The ITS data support the circumscription of species based on morphological characters and are useful in aiding species delimitations. The ITS data do not, however, support the current sectional delimitation of *Marasmius* wherein most sections are not monophyletic. Comprehensive descriptions, illustrations and photographs of each species, a key to aid in diagnosis, comparisons with allied species, and a preliminary phylogenetic construct are provided.

**Key words:** agarics, Agaricales, mating studies, phylogeny, taxonomy

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### Introduction

Malaysia is one of the mega-diverse countries for most groups of organisms including fungi; however, the diversity of macrofungi and in particular *Marasmius* species in Malaysia is poorly known. The genus *Marasmius* (Basidiomycota, Agaricales, Marasmiaceae) was first established in 1835 by Elias Magnus Fries. Species in the genus are decomposer fungi that colonize leaf litter, twigs, trapped debris, lianas and dead wood (Hedger *et al.*, 1993; Singer, 1986). More than 1700 epithets have been published to date in *Marasmius* although it is suspected that these represent only about 500-600 species worldwide (Desjardin unpubl.) The diversity of *Marasmius* is strongly correlated with the diversity of plants in the habitats where they occur, with a higher diversity in tropical areas and fewer species in temperate areas (Lodge *et al.*, 1995; Desjardin unpubl.). Because *Marasmius* species are saprotrophic they serve

many important ecological roles in litter decomposition, nutrient cycling, soil genesis and as a food source for myriad molluscs, arthropods and small vertebrates. Favourable temperature and humidity conditions in Asian tropical forests support a wide diversity of *Marasmius* species. However, the unpredictable seasonality of fruiting and the short-lived and often solitary fruiting bodies are major problems encountered when documenting their diversity in tropical forests.

E.J.H. Corner was one of the early researchers who studied macrofungi from the Malesian region. He published a preliminary account of *Marasmius sensu lato* in which he reported 121 species of which 103 represented new species (Corner, 1996). Corner had accepted a much broader generic concept of *Marasmius* than most contemporary workers, and he included taxa that are now accepted in the genera *Gymnopus*, *Hemimycena*, *Marasmiellus*, *Moniliophthora*, *Rhodocollybia*, *Setulipes* and *Tetrapyrgos*. Although most of

the species described as *Marasmius* by Corner (1996) either do not belong to that genus or are superfluous epithets, Corner's study provided essential preliminary data and quality specimens (at E) of *Marasmius sensu lato* from the Malaysian area. Since Corner, there has been no monographic study on the genus *Marasmius* in Malaysia.

Singer (1958a,b) was one of the pioneers in developing the generic and infrageneric circumscriptions of *Marasmius* and allied genera. In subsequent years (Singer, 1976, 1986) he refined his taxonomic construct and restricted *Marasmius* to include only species with smooth, hyaline, inamyloid, acyanophilic basidiospores in combination with macro- and micromorphological characters distinguished mainly by the absence of features: viz., an absence of long dextrinoid hairs, an absence of strongly gelatinized tissues, and by a pileipellis that lacks a trichodermial palisade of smooth and elongated cells. Singer (1976) recognized 11 sections within *Marasmius* and this classification system has been followed (with a few exceptions) by contemporary researchers (Gilliam, 1976; Antonin and Noordeloos, 1993; Desjardin *et al.*, 2000). In this study, *Marasmius* was restricted to a monophyletic lineage containing only sections *Marasmius*, *Sicci*, *Hygrometrici*, *Globulares*, *Neosessiles*, and *Leveilleani* based on Wilson and Desjardin (2005). *Marasmius* is the sister taxon of *Crinipellis* and *Chaetocalathus* species (Moncalvo *et al.*, 2002; Wilson and Desjardin, 2005). A re-evaluation of the diversity of *Marasmius sensu stricto*, based on extensive new field studies in numerous primary forests in Peninsular Malaysia, on the examination of type specimens and additional exsiccati (dried specimen), and on molecular sequences data was the focus of this research.

## Materials and methods

### Morphological descriptions

Samples of the genus *Marasmius* were collected in various forests in Peninsular Malaysia as itemized in Table 1 and Fig. 1. 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:  $x_m$ , 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. Dried collections were accessioned into the Mycology Herbarium (KLU-M) at University of Malaya, Kuala Lumpur and into the Harry D. Thiers Herbarium (SFSU) at San Francisco State University.

## Phylogenetic study

### Taxon Sampling

Molecular sequence data were generated for 40 species of *Marasmius*. Of these, 36 represent Malaysian species and three are North American in distribution. A sequence of *Marasmius rotula* (DQ182506), type species of *Marasmius*, was obtained from GenBank and included in the analyses. Three species of *Crinipellis* were chosen as outgroup taxa for rooting purposes, based on previous results (Moncalvo *et al.*, 2002; Wilson and Desjardin, 2005) that indicated a sister-relationship between *Crinipellis* and *Marasmius*. All specimens used in this study are listed in Table 2.

### Molecular techniques

The entire region of the internal transcribed spacers (ITS-1 and ITS-2), including the 5.8S gene, was analyzed in this study. Genomic DNA was extracted from dried herbarium material using an E.Z.N.A. forensic DNA kit (Omega Bio-tek Inc., Doraville, Georgia), and amplified using primers ITS1-F and ITS4-B (Gardes and Bruns, 1993) or ITS4

**Table 1.** Collecting sites sampled for this study.

No.	Area	Location	Type of Forest
1.	Ulu Gombak forest area, Selangor.	N 03°19', E 101°45'	Tropical lowland rainforest
2.	University of Malaya's Field Study Centre, Ulu Gombak, Selangor.	N 03°19', E 101°45'	Tropical lowland rainforest
3.	Sungai Chongkak Forest Reserve, Ulu Langat, Selangor.	N 03°12', E 101°50'	Tropical lowland rainforest
4.	Mount Nuang Forest Reserve, Ulu Langat, Selangor	N 03°12', E 101°52'	Highland forest
5.	Kanching Forest Reserve, Rawang, Selangor.	N 03°20', E 101°35'	Tropical lowland rainforest
6.	MNS Heritage Trail, MNS Kuala Lumpur.	N 03°09', E 101°41'	Tropical lowland rainforest
7.	Fraser's Hill, Pahang.	N 03°42', E 101°44'	Highland forest
8.	Cameron Highlands, Pahang.	N 04°27', E 101°22'	Highland forest
9.	Langkawi Island, Kedah.	N 06°25', E 99°45'	Tropical lowland rainforest
10.	Pasoh Forest Reserve, Negeri Sembilan.	N 02°59', E 102°19'	Tropical lowland forest
11.	Ulu Bendul Forest Reserve, Negeri Sembilan	N 2°42', E 101°54'	Tropical lowland rainforest
12.	Endau-Rompin National Park, Johore	N 02°25', E 103°5'	Virgin lowland rainforest

(White *et al.*, 1990). The amplification reaction mixture typically contained the following: 2.5 µl of dNTP, 1.25 µl of MgCl<sub>2</sub>, 1.25 µl of each primer, 1.9 µl of BSA, 0.1 µl of taq polymerase, 2.5-5 buffer, and 2.5 µl of DNA template, eluted to a final volume of 25 µl. The amplification protocol consisted of 2 min at 95 °C, followed by 35 cycles of 30 sec at 94 °C, 30 sec at 46 °C to 54 °C, and 1 min at 72 °C, followed by a final extension of 5 min at 72 °C. Sequencing reactions utilized the same primers as PCR, and were purified using an isopropanol precipitation. 125 µl of 65% isopropanol was added to the sequencing reactions, vortexed and centrifuged at 15000 rpm for 35 min. The supernatant was removed, 125 µl of 75 % isopropanol was added, vortexed and centrifuged at 15000 rpm for additional 10 min. Again, the supernatant was removed and the pellet was air-dried for 30 min. Clean sequencing reactions were suspended in 15 µl Hi-Di formamide (Applied Biosystems), and visualized on an ABI 3100 Genetic Analyzer (Applied Biosystems, Foster City, CA).

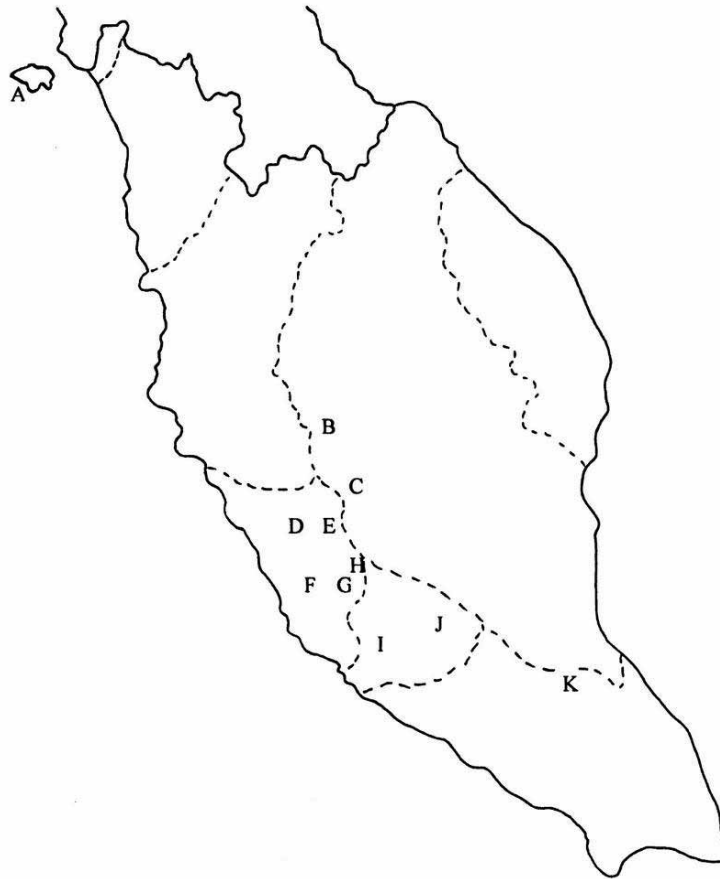
Sequence fragments were edited and assembled with Sequencher v.3.1.1 (Gene Codes Corp., Ann Arbor, Michigan). ITS sequence data were initially aligned with

Clustal X v.1.81 (Thompson *et al.*, 1997) using the default settings, followed by manual alignment with MacClade v.4.03 (Maddison and Maddison, 2001). Edited sequences have been deposited in GenBank (Table 2), and the aligned dataset used for all analyses is available on TreeBase (S2230; <http://www.treebase.org>).

#### **Phylogenetic Analyses**

Parsimony analyses were performed in PAUP\* v.4.0b (Swofford, 2002) utilizing heuristic search methods, with 100 random stepwise sequence addition replicates, tree bisection-reconnection (TBR), collapse of zero length branches, and maxtrees set to 10,000. All characters were equally weighted and unordered, and gaps were treated as missing data. Parsimony bootstrap (PB) analysis was performed using 1000 bootstrap replicates, each with a limit of 1,000,000 rearrangements, closest taxon addition, and TBR branch swapping.

The appropriate model of sequence evolution for the ITS data was estimated using the Akaike Information Criterion (AIC) as implemented in Modeltest version 3.7 (Posada and Crandall, 1998) and MrModeltest



**Fig.1.** Collecting sites for the genus *Marasmius* in Peninsular Malaysia. A: Langkawi Island, Kedah; B: Cameron Highlands, Pahang; C: Fraser’s Hill, Pahang; D: Kanching Forest Reserve, Selayang, Selangor; E: Ulu Gombak Forest Reserve area, Selangor; F: MNS Heritage Trail, Kuala Lumpur; G: Sungai Chongkak Forest Reserve, Ulu Langat, Selangor; H: Mount Nuang Forest Reserve, Ulu Langat, Selangor; I: Ulu Bendul Forest Reserve, Negeri Sembilan; J: Pasoh Forest Reserve, Negeri Sembilan; K: Endau-Rompin National Park, Johore.

(Nylander, 2004). Maximum likelihood (ML) and searches employed the TrN+I+G model of sequence evolution. ML topology searches were performed in PAUP\* v.4.0b, and followed an iterative approach. First, a neighbor-joining tree was constructed from which the ML model parameters were estimated. Next, the estimated parameter values were fixed and a ML search was performed. The resulting tree(s) from this search were then used to re-estimate the parameter values, fixed, and another likelihood search was conducted. This re-estimation and search step was repeated two additional times, for a total of three ML searches, to assure that all three searches had converged on equally likely topologies. ML bootstrap analyses were performed in GARLI v.0.951 (Zwickl, 2006) and consisted of 300 replicates under a GTR+I+G model of sequence evolution, using

the default run termination settings.

Bayesian analyses were performed in MrBayes v.3.1.2 (Huelsenbeck and Ronquist 2001, Ronquist and Huelsenbeck 2003) under a GTR+I+G model of sequence evolution. Analyses consisted of two parallel searches, run for 6 million generations each and initiated with random starting trees. The default settings in MrBayes were used for the incremental heating scheme, and to set unconstrained branch lengths [unconstrained: exponential (10.0)] and uninformative topology priors. Chains were sampled every 500 generations for a total 12,001 trees from each run, sampled from the posterior distribution. Trees sampled prior to the chains reaching a split deviation frequency of 0.03 were discarded as the “burn-in”, while the remaining trees were used to calculate the posterior possibilities (PP) of the clades.

**Table 2.** Species, collection information and GenBank accession numbers of specimens used in the phylogenetic analyses.

Sample	Specimen ID	Location	Herbarium	Genbank
<i>Crinipellis brunneipurpurea</i> Corner	JFK 84	Indonesia	SFSU	FJ167646
<i>Crinipellis dipteroearpi</i> Singer	TYS 111	Malaysia-Pahang	SFSU	FJ431208
<i>Crinipellis malesiana</i> nom. prov.	TYS 346	Malaysia-Kedah	SFSU	FJ167628
<i>Marasmius abundans</i> Corner var. <i>abundans</i>	TYS 425	Malaysia-Selangor	KLU, SFSU	FJ431212
<i>Marasmius abundans</i> Corner var. <i>abundans</i>	TYS 460	Malaysia-Selangor	KLU, SFSU	FJ431210
<i>Marasmius abundans</i> Corner var. <i>abundans</i>	TYS 513	Malaysia-Johore	KLU, SFSU	FJ431209
<i>Marasmius abundans</i> var. <i>aurantiacus</i> Corner	TYS 515	Malaysia-Johore	KLU, SFSU	FJ431211
<i>Marasmius acerosus</i> Y.S. Tan & Desjardin	TYS 458-Holotype	Malaysia-Selangor	KLU, SFSU	FJ431213
<i>Marasmius acerosus</i> Y.S. Tan & Desjardin	TYS 427	Malaysia-Selangor	KLU, SFSU	FJ431214
<i>Marasmius aciebrunneus</i> Corner	TYS 457	Malaysia-Selangor	KLU, SFSU	FJ431215
<i>Marasmius adhaesus</i> Corner	TYS 464	Malaysia-Selangor	KLU, SFSU	FJ431217
<i>Marasmius adhaesus</i> Corner	TYS 467	Malaysia-Selangor	KLU, SFSU	FJ431216
<i>Marasmius angustilamellatus</i> Y.S. Tan & Desjardin	TYS 437	Malaysia-Selangor	KLU, SFSU	FJ431218
<i>Marasmius angustilamellatus</i> Y.S. Tan & Desjardin	TYS 524-Holotype	Malaysia-Selangor	KLU, SFSU	FJ431219
<i>Marasmius angustilamellatus</i> Y.S. Tan & Desjardin	TYS 528	Malaysia-Selangor	KLU, SFSU	FJ431220
<i>Marasmius aratus</i> Masee nom. <i>illegit.</i>	KUM 152	Malaysia-Selangor	KLU, SFSU	FJ431221
<i>Marasmius araucariae</i> var. <i>siccipes</i> Desjardin, Retn. & E. Horak	TYS 529	Malaysia-Selangor	KLU, SFSU	FJ431222
<i>Marasmius araucariae</i> var. <i>siccipes</i> Desjardin, Retn. & E. Horak	MY 38	Malaysia-Selangor	KLU, SFSU	FJ431223
<i>Marasmius bambusiniformis</i> Singer	TYS 511	Malaysia-Johore	KLU, SFSU	FJ431224
<i>Marasmius berambutanus</i> Desjardin, Retn. & E. Horak	TYS 337	Malaysia-Kedah	KLU, SFSU	FJ431225
<i>Marasmius berambutanus</i> Desjardin, Retn. & E. Horak	TYS 398	Malaysia-Selangor	KLU, SFSU	FJ431227
<i>Marasmius berambutanus</i> Desjardin, Retn. & E. Horak	TYS 503	Malaysia-Johore	KLU, SFSU	FJ431226
<i>Marasmius brevicollus</i> Corner	TYS 517	Malaysia-Johore	KLU, SFSU	FJ431228
<i>Marasmius</i> aff. <i>camerunensis</i> Antonin & Mossebo	KUM 60134	Malaysia-Kedah	KLU, SFSU	FJ431229
<i>Marasmius cohaerens</i> var. <i>lachnophyllus</i> (Berk.) Gilliam	DED 4071	USA-Tennessee	SFSU	FJ431230
<i>Marasmius crinis-equi</i> F. Muell. ex Kalchbr.	TYS 338	Malaysia-Kedah	KLU, SFSU	FJ431233
<i>Marasmius crinis-equi</i> F. Muell. ex Kalchbr.	TYS 341	Malaysia-Kedah	KLU, SFSU	FJ431232
<i>Marasmius crinis-equi</i> F. Muell. ex Kalchbr.	TYS 366	Malaysia-Negeri Sembilan	KLU, SFSU	FJ167669
<i>Marasmius crinis-equi</i> F. Muell. ex Kalchbr.	TYS 367	Malaysia-Negeri Sembilan	KLU, SFSU	FJ431234
<i>Marasmius crinis-equi</i> F. Muell. ex Kalchbr.	TYS 412	Malaysia-Selangor	KLU, SFSU	FJ431236
<i>Marasmius crinis-equi</i> F. Muell. ex Kalchbr.	TYS 447	Malaysia-Selangor	KLU, SFSU	FJ431235
<i>Marasmius crinis-equi</i> F. Muell. ex Kalchbr.	TYS 466	Malaysia-Selangor	KLU, SFSU	FJ431231
<i>Marasmius diminutivus</i> Y.S. Tan, Desjardin & Vikineswary	TYS 514-Holotype	Malaysia-Johore	KLU, SFSU	FJ431238
<i>Marasmius distantifolius</i> Y.S. Tan & Desjardin	TYS 478-Holotype	Malaysia-Selangor	KLU, SFSU	FJ431239
<i>Marasmius florideus</i> Berk. & Broome	TYS 480	Malaysia-Selangor	KLU, SFSU	FJ431240

**Table 2 (Continued).** Species, collection information and GenBank accession numbers of specimens used in the phylogenetic analyses.

<b>Sample</b>	<b>Specimen ID</b>	<b>Location</b>	<b>Herbarium</b>	<b>Genbank</b>
<i>Marasmius gracilichorda</i> Corner	TYS 396	Malaysia-Selangor	KLU, SFSU	FJ431242
<i>Marasmius gracilichorda</i> Corner	TYS 411	Malaysia-Selangor	KLU, SFSU	FJ431244
<i>Marasmius gracilichorda</i> Corner	TYS 442	Malaysia-Selangor	KLU, SFSU	FJ431241
<i>Marasmius gracilichorda</i> Corner	TYS 472	Malaysia-Selangor	KLU, SFSU	FJ431243
<i>Marasmius guyanensis</i> Mont.	TYS 028	Malaysia-Selangor	KLU, SFSU	FJ431245
<i>Marasmius guyanensis</i> Mont.	TYS 329	Malaysia-Kedah	KLU, SFSU	FJ431247
<i>Marasmius guyanensis</i> Mont.	TYS 395	Malaysia-Selangor	KLU, SFSU	FJ431246
<i>Marasmius haematocephalus</i> (Mont.) Fr.	TYS 523	Malaysia-Selangor	KLU, SFSU	FJ431248
<i>Marasmius iras</i> Y.S. Tan & Desjardin	TYS 483-Holotype	Malaysia-Selangor	KLU, SFSU	FJ431249
<i>Marasmius kanchingensis</i> Y.S. Tan & Desjardin	TYS 415-Holotype	Malaysia-Selangor	KLU, SFSU	FJ431250
<i>Marasmius kuthubutheenii</i> Y.S. Tan, Desjardin, Vikineswary & Noorlidah	TYS 348	Malaysia-Selangor	KLU, SFSU	FJ431252
<i>Marasmius kuthubutheenii</i> Y.S. Tan, Desjardin, Vikineswary & Noorlidah	TYS 364-Holotype	Malaysia-Negeri Sembilan	KLU, SFSU	FJ431251
<i>Marasmius leucorotalis</i> Singer	TYS 489	Malaysia-Johore	KLU, SFSU	FJ431253
<i>Marasmius</i> aff. <i>leoninus</i> Berk.	TYS 423	Malaysia-Selangor	KLU, SFSU	FJ431254
<i>Marasmius leveilleanus</i> (Berk.) Pat.	KUM 60142	Malaysia-Kedah	KLU, SFSU	FJ431256
<i>Marasmius leveilleanus</i> (Berk.) Pat.	KUM 116a	Malaysia-Kedah	KLU, SFSU	FJ431255
<i>Marasmius luteomarginatus</i> Desjardin, Retn. & E. Horak	TYS 477	Malaysia-Selangor	KLU, SFSU	FJ431257
<i>Marasmius micraster</i> Petch	TYS 229	Malaysia-Pahang	KLU, SFSU	FJ431259
<i>Marasmius micraster</i> Petch	TYS 237	Malaysia-Selangor	KLU, SFSU	FJ431260
<i>Marasmius micraster</i> Petch	TYS 391	Malaysia-Selangor	KLU, SFSU	FJ431258
<i>Marasmius micraster</i> Petch	DED 7647	Malaysia-Selangor	KLU, SFSU	FJ431261
<i>Marasmius musicolor</i> Y.S. Tan & Desjardin	TYS 417-Holotype	Malaysia-Selangor	KLU, SFSU	FJ431262
<i>Marasmius ochropoides</i> Y.S. Tan & Desjardin	TYS 384-Holotype	Malaysia-Selangor	KLU, SFSU	FJ431263
<i>Marasmius ochropoides</i> Y.S. Tan & Desjardin	TYS 416	Malaysia-Selangor	KLU, SFSU	FJ431264
<i>Marasmius olivascens</i> Y.S. Tan & Desjardin	TYS 424	Malaysia-Selangor	KLU, SFSU	FJ431266
<i>Marasmius olivascens</i> Y.S. Tan & Desjardin	TYS 426-Holotype	Malaysia-Selangor	KLU, SFSU	FJ431265
<i>Marasmius oreades</i> (Bolton) Fr.	PBM 2701	USA-Massachusetts	-	DQ490641
<i>Marasmius oreades</i> (Bolton) Fr.	HDT 51606	USA-Santa Barbara	SFSU	FJ431267
<i>Marasmius purpureostriatus</i> Hongo	TYS 328	Malaysia-Kuala Lumpur	KLU, SFSU	FJ431268
<i>Marasmius rotula</i> (Scop.) Fr.	PBM 2563	New Hampshire	-	DQ182506
<i>Marasmius ruforotula</i> Singer	TYS 369	Malaysia-Negeri Sembilan	KLU, SFSU	FJ431269
<i>Marasmius ruforotula</i> Singer	TYS 438	Malaysia-Selangor	KLU, SFSU	FJ431271
<i>Marasmius ruforotula</i> Singer	TYS 509	Malaysia-Johore	KLU, SFSU	FJ431270
<i>Marasmius selangorensis</i> Y.S. Tan & Desjardin	TYS 435	Malaysia-Selangor	KLU, SFSU	FJ431274
<i>Marasmius selangorensis</i> Y.S. Tan & Desjardin	TYS 453-Holotype	Malaysia-Selangor	KLU, SFSU	FJ431273
<i>Marasmius selangorensis</i> Y.S. Tan & Desjardin	TYS 454	Malaysia-Selangor	KLU, SFSU	FJ431275

**Table 2 (Continued).** Species, collection information and GenBank accession numbers of specimens used in the phylogenetic analyses.

<b>Sample</b>	<b>Specimen ID</b>	<b>Location</b>	<b>Herbarium</b>	<b>Genbank</b>
<i>Marasmius siccus</i> (Schwein.) Fr.	DED 5255	USA-Tennessee	SFSU	FJ431272
<i>Marasmius tenuissimus</i> (Jungh.) Singer	TYS 345	Malaysia-Kedah	KLU, SFSU	FJ431277
<i>Marasmius tenuissimus</i> (Jungh.) Singer	TYS 468	Malaysia-Selangor	KLU, SFSU	FJ431276
<i>Marasmius tenuissimus</i> (Jungh.) Singer	DED 7659	Malaysia-Pahang	KLU, SFSU	FJ431278
<i>Marasmius tubulatus</i> Petch	TYS 490	Malaysia-Johore	KLU, SFSU	FJ431281
<i>Marasmius tubulatus</i> Petch	TYS 502	Malaysia-Johore	KLU, SFSU	FJ431280
<i>Marasmius tubulatus</i> Petch	TYS 518	Malaysia-Johore	KLU, SFSU	FJ431279

## Results and Discussion

Seventy-seven new ITS rDNA sequences were generated as part of this study. Sequence data were not obtained for five additional Malaysian *Marasmius* species (*M. nummularioides*, *M. persicinus*, *M. purpureo-brunneolus*, *M. purpureisetosus* and *M. somalomoensis*) due to the presence of multiple ITS amplification products. Sequence length ranged from 695 bp in *M. crinis-equi* to 963 bp in *M. micraster*. Several regions of the sequence data, totaling 117 nucleotides, were ambiguous in their alignment and excluded from all analyses. Sequence ends were trimmed to account for missing data in several taxa, creating a final alignment of 551 characters for 77 ingroup and three outgroup taxa. Of the 551 characters comprising the dataset, 153 were parsimony informative.

Parsimony search found 29822 equally parsimonious trees of 680 steps long (CI= 0.4088, RI= 0.7561). The maximum likelihood search converged on a stable average likelihood of  $-\ln L = 6033.7657$  (Fig. 2). The topology of the parsimony and ML trees were similar, varying only in the arrangement of a few species within terminal clades. Bayesian analyses reached a split deviation frequency  $< 0.03$  after six million generations, and the first 5812 trees were excluded as the burn-in.

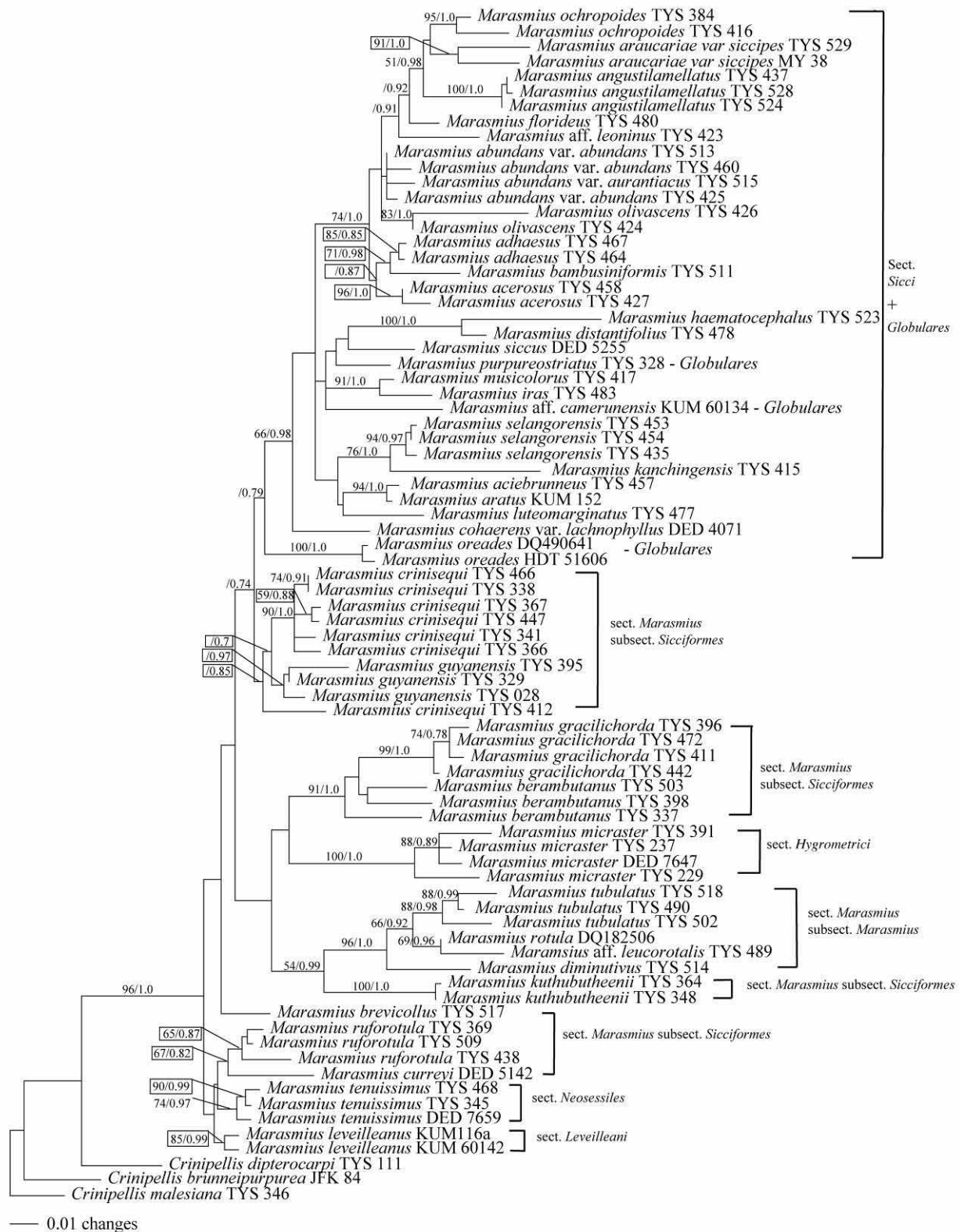
All *Marasmius* species included in these analyses belong to a monophyletic lineage supported by 96% ML bootstrap (BS) and 1.0 posterior probability (PP) values. The nodes representing potential infrageneric groups are not well supported. Species currently recognized as belonging to the sections *Sicci* and *Globulares* fall into a clade with limited support ( $< 50\%$  BS and 0.79 PP); however, neither section is monophyletic. Sect. *Marasmius*, representing species with a collarium, is not monophyletic. Sect. *Marasmius* subsect. *Sicciformes* (species with a collarium and *Siccus*-type broom cells) is not monophyletic, with members clustering into four separate clades with statistical support for each clade ranging from  $< 50\%$  BS and 0.85 PP to 91% BS and 1.0 PP. Sect. *Marasmius* subsect. *Marasmius* (species with a collarium and *Rotalis*-type broom cells) is monophyletic for

the four included species with 96% BS and 1.0 PP support. Only a single member of sect. *Hygrometrici* was included in the analyses and it is sister of two members of sect. *Marasmius* subsect. *Sicciformes* but without statistical support. The single member of sect. *Neosessiles* is sister of two members of *Marasmius* subsect. *Sicciformes* but without statistical support, and the single member of sect. *Leveilleani* is sister of these clades but again without statistical support.

In general, sequences representing individuals belonging to the same morpho-species form well-resolved clades with high statistical support. For example, three specimens of the new species *M. angustilamellatus* that were collected in geographically distant sites form a clade with 100% BS and 1.0 PP support and show little genetic diversity. Only *M. crinis-equi* broke this rule with a single collection (TYS 412) resolving as sister of a clade containing *M. guyanensis* plus the remaining *M. crinis-equi* specimens but with  $< 50\%$  BS and 0.85 PP support. Five additional specimens of *M. crinis-equi* form a clade with 90% BS and 1.0 PP support. In a few cases genetic diversity within species is quite high. For example, the two specimens of the new species *M. olivascens* that form a clade supported by 83% BS and 1.0 PP values were collected on the same day at the same site but TYS 426 is on a long branch relative to TYS 424.

The genus *Marasmius* was restricted according to Wilson & Desjardin (2005) to include only members belonging to the sections *Marasmius*, *Hygrometrici*, *Leveilleani*, *Scotophysini*, *Sicci*, *Neosessiles* and *Globulares* as defined by Singer (1976, 1986). Members of all of these infrageneric groups, except *Scotophysini*, occur in Malaysia and are represented in the molecular phylogenetic analyses (Fig. 2). Representatives of the other sections traditionally recognized within *Marasmius* by Singer (1976, 1986) and others were not included in this study; viz., *Marasmius* sect. *Androsacei* as the genus *Setulipes* (Antonín and Noordeloos, 1993); sect. *Fusicystides* as a synonym of *Setulipes* (Desjardin, unpubl.); sect. *Alliacei* as the genus *Mycetinis* (Wilson and Desjardin, 2005); and





**Fig. 2.** Maximum likelihood tree using a GTR+I+G model of evolution. Numbers above branches at the left are bootstrap percentage and the right are posterior probability values (Bayesian MCMC analysis).

sect. *Epiphylli* as a distinct genus allied with *Gloiocephala* in the Physalacriaceae (Desjardin, unpubl.). As a consequence of our delimitation of *Marasmius sensu stricto* and a sampling design influenced by the nLSU DNA dataset of Wilson and Desjardin (2005), this study based on ITS sequences also resolved a monophyletic *Marasmius* with high statistical support.

Species concepts based on shared morphological features were well supported by the ITS data. In nearly all cases, specimens assigned to a morphospecies clustered in well-resolved clades supported by high BS and PP values. The same cannot be said for the ability of ITS data to resolve infrageneric groups. Of the six sections of *Marasmius* recognized in this study, none are monophyletic. It should be noted, however, that sect. *Leveilleani* is monotypic (*M. leveilleanus* is the only species) and we included only one representative each of sects. *Hygrometrici* and *Neosessiles* so monophylly of these groups could not be tested. Nonetheless, the diverse sects. *Marasmius*, *Sicci* and *Globulares* are not monophyletic in these analyses. The addition of sequences from other genes (nLSU, mtSSU, rpb1, rpb2) will be necessary to clearly delimit infrageneric groups within *Marasmius*. Until those data become available, the infrageneric delimitations as circumscribed by Singer (1976, 1986) and Desjardin *et al.* (2005) will be recognized.

All species of *Marasmius* with *Siccus*-type broom cells or *Globulares*-type pileipellis cells in combination with a non-insititious stipe and the absence of a collarium (*viz.*, sects. *Sicci* and *Globulares*) formed a monophyletic group with limited statistical support (Fig. 2). The type species of sect. *Sicci*, *M. siccus* (Schwein.) Fr., is included in the analyses. The type species of sect. *Globulares*, *M. wynneae* Berk. & Broome, is not included although a common European and North American representative, *M. oreades* (Bolton: Fr.) Fr., is included. The data suggest that the presence of *Siccus*-type broom cells versus *Globulares*-type cells forming the pileipellis tissue, which is the defining character distinguishing sect. *Sicci* from sect. *Globulares*, is not phylogenetically significant. This observation is not surprising in that a number of species traditionally accepted in sect. *Sicci* have both *Siccus*-type broom cells and *Globulares*-type

cells forming the pileipellis. Desjardin and Horak (1997) recognized this when they described *M. nexus* from material collected in Papua New Guinea and noted that the species was morphologically intermediate between these two sections (and hence their use of the epithet *nexus*). The data support recognition of a single infrageneric group to accommodate species currently accepted in sects. *Sicci* and *Globulares*.

Section *Sicci* was subdivided into two subsections by Singer (1976) based on whether the pileus tramal tissues are inamyloid (subsect. *Inaequales*) or dextrinoid (subsect. *Siccini*). Subsect. *Inaequales* is monotypic, and the single species, *M. inaequalis* Berk. & M.A. Curtis, is known only from the New World (Caribbean and South America) and is not included in these analyses. Subsect. *Siccini* is further subdivided into series based on the presence or absence of pleurocystidia, setae and cylindrical (non-setoid) caulocystidia. Currently recognized series include: ser. *Spinulosi*, with setae on the pileus, lamellae and/or stipe (type – *M. cohaerens* (Pers.: Fr) Cooke & Quél.); ser. *Atrorubentes*, with cylindrical, non-setoid cystidia on stipe (type – *M. atrorubens* (Berk.) Berk.); ser. *Leonini*, without pleurocystidia (type – *M. leoninus* Berk.); and ser. *Haematocephali*, with pleurocystidia (type – *M. haematocephalus* (Mont.) Fr.). The ITS data indicate that ser. *Atrorubentes* and *Leonini* are not monophyletic. Representatives of ser. *Atrorubentes*, *viz.*, *M. ochropoides*, *M. musicolor* and *M. iras*, do not form a single clade, although the latter two species are monophyletic with 91% BS and 1.0 PP values. Hence, the presence of cylindrical, non-setoid caulocystidia plus absence of *Siccus*-type caulocystidia are not phylogenetically informative features. The monophylly of ser. *Spinulosi*, represented in Malaysia by only one species, *M. nummularioides*, could not be tested. We were unable to obtain quality sequences of *M. nummularioides* because of multiple different ITS copies in the specimens studied; therefore, no data on the phylogenetic placement of this species is available. The type species of ser. *Spinulosi*, *M. cohaerens*, was sister of all other members of sect. *Sicci* with 66% BS and 0.98 PP values. The three members of ser. *Haematocephali* included in

the analyses, viz., *M. siccus*, *M. distantifolius* and *M. haematocephalus* (type species of the series), did cluster in one clade but without statistical support. It is possible that the presence of pleurocystidia is a phylogenetically informative feature but more data are needed before this supposition is supported. Representatives of ser. *Leonini* are scattered through the sects. *Sicci* + *Globulares* clade, suggesting that the absence of pleurocystidia alone is not phylogenetically informative.

All species of *Marasmius* that produce a collarium to which the lamellae adhere (viz., sect. *Marasmius*) do not form a monophyletic clade in the ITS analyses (Fig. 2). Historically, sect. *Marasmius* has been circumscribed to include species with an insititious, wiry stipe and lamellae attached to a collarium. It is subdivided into subsect. *Marasmius* that includes species with *Rotalis*-type broom cells, and subsect. *Sicciformes* that includes species with *Siccus*-type broom cells. In the ITS dataset, only subsect. *Marasmius*, here represented by the type species of *Marasmius* (*M. rotula* (Scop.: Fr.) Fr.) and three additional Malaysian species, is monophyletic with strong support (96% BS, 1.0 PP). In comparison, members of subsect. *Sicciformes* form four distinct clades that do not share a common ancestor. Interestingly, sect. *Hygrometrici* that shares the features of an insititious, wiry stipe and *Rotalis*-type broom cells with sect. *Marasmius* subsect. *Marasmius* is not sister of the latter group but instead is sister of two species in subsect. *Sicciformes* that form *Siccus*-type broom cells. This was a surprising result, although it should be noted that there is no statistical support for this topology and the nodes delimiting the various clades containing members of subsect. *Sicciformes* and sects. *Hygrometrici*, *Neosessiles* and *Leveilleani* collapse in a consensus tree.

Although there is no statistical support for definitive conclusions regarding infrageneric circumscriptions and relationships, it is interesting that *M. tenuissimus*, the only representative of sect. *Neosessiles* (a group defined by the absence of a stipe or the presence of a rudimentary, lateral stipe in combination with *Siccus*-type broom cells) is sister of two members of subsect. *Sicciformes* (species with a collarium) and not sister of or

within sect. *Sicci* (species lacking a collarium). Based on its overall basidiome size and lack of a collarium on those basidiomes that form a rudimentary stipe it was expected to have a close relationship with sect. *Sicci*. The morphology of the *Siccus*-type broom cells developed by *M. tenuissimus* (with short, knobby or forked setulae) are similar to those formed by *M. ruforotula* and *M. curreyi*, and distinct from those formed by most members of sect. *Sicci* (with long, acutely conical setulae), thereby supporting the putative relationship indicated in Fig. 2. *Marasmius leveilleanus*, the only member of sect. *Leveilleani*, also shares this distinctive form of *Siccus*-type broom cells in combination with a wiry, insititious stipe, so it is not surprising that it resolves sister of the clade containing *M. tenuissimus*, *M. ruforotula* and *M. curreyi* (but again with no statistical support). Whether any of these suggested but unsupported relationships are resolved in phylogenetic analyses based on multiple loci datasets remains to be seen.

Basidiospore size, another useful taxonomic feature, is apparently not phylogenetically significant beyond informing of closely related species. For an example in sect. *Sicci*, *M. aratus* and *M. aciebrunneus*, species with basidiospore mean length between 25–27 µm form a clade supported by 94% BS and 1.0 PP values, but they are not sister of *M. adhaesus*, a species with basidiospore mean length of 26 µm. Rather *M. adhaesus* is sister of *M. bambusiniformis* (with 71% BS and 0.98 PP support), a species with basidiospore mean length of 17 µm.

In summary, the ITS data support the recognition of morphospecies but do not support the current infrageneric delimitation of *Marasmius* although they do help focus the direction of further research

### Synopsis of *Marasmius sensu stricto* of Peninsular Malaysia

Sect. *Marasmius*, subsect. *Marasmius*

1. *Marasmius tubulatus* Petch
2. *Marasmius somalomoensis* Antonín
3. *Marasmius diminutivus* Y.S. Tan, Desjardin & Vikineswary, **sp. nov.**
4. *Marasmius leucorotalis* Singer

Sect. *Marasmius*, subsect. *Sicciformes*

5. *Marasmius purpureisetosus* Corner
6. *Marasmius berambutanus* Desjardin, Retn. & E. Horak
7. *Marasmius brevicollis* Corner
8. *Marasmius purpureobrunneolus* Henn.
9. *Marasmius guyanensis* Mont.
10. *Marasmius crinis-equi* F. Muell. ex Kalchbr.
11. *Marasmius kuthubutheenii* Y.S. Tan, Desjardin, Vikineswary & Noorlidah, **sp. nov.**
12. *Marasmius gracilichorda* Corner
13. *Marasmius ruforotula* Singer  
Sect. *Globulares*
14. *Marasmius* aff. *camerunensis* Antonín & Mossebo
15. *Marasmius purpureostriatus* Hongo  
Sect. *Neosessiles*
16. *Marasmius tenuissimus* (Jungh.) Singer  
Sect. *Hygrometrici*
17. *Marasmius micraster* Petch  
Sect. *Leveilleani*
18. *Marasmius leveilleanus* (Berk.) Pat.  
Sect. *Sicci*, subsect. *Siccini*, ser. *Spinulosi*
19. *Marasmius nummularioides* Desjardin & Y.S. Tan  
Sect. *Sicci*, subsect. *Siccini*, ser. *Atrorubentes*
20. *Marasmius musicolor* Y.S. Tan & Desjardin, **sp. nov.**
21. *Marasmius ochropoides* Y.S. Tan & Desjardin, **sp. nov.**
22. *Marasmius iras* Y.S. Tan & Desjardin, **sp. nov.**  
Sect. *Sicci*, subsect. *Siccini*, ser. *Leonini*
23. *Marasmius* aff. *leoninus* Berk.
24. *Marasmius araucariae* var. *siccipes* Desjardin, Retn. & E. Horak
25. *Marasmius luteomarginatus* Desjardin, Retn. & E. Horak
26. *Marasmius jasminodorus* Wannathes, Desjardin & Lumyong
27. *Marasmius angustilamellatus* Y.S. Tan & Desjardin, **sp. nov.**
28. *Marasmius olivascens* Y.S. Tan & Desjardin, **sp. nov.**
29. *Marasmius florideus* Berk. & Broome
30. *Marasmius acerosus* Y.S. Tan & Desjardin
31. *Marasmius bambusiniiformis* Singer
32. *Marasmius abundans* Corner var. *abundans*
33. *Marasmius abundans* var. *aurantiacus* Corner

34. *Marasmius abundans* var. *campanulatus* Corner
35. *Marasmius persicinus* Desjardin, Retn. & E. Horak
36. *Marasmius corneri* Wannathes, Desjardin & Lumyong
37. *Marasmius selangorensis* Y.S. Tan & Desjardin
38. *Marasmius kanchingensis* Y.S. Tan & Desjardin, **sp. nov.**
39. *Marasmius aratus* Masee
40. *Marasmius aciebrunneus* Corner
41. *Marasmius adhaesus* Corner  
Sect. *Sicci*, subsect. *Siccini*, ser. *Haematocephali*
42. *Marasmius distantifolius* Y.S. Tan & Desjardin, **sp. nov.**
43. *Marasmius haematocephalus* (Mont.) Fr.

#### **Artificial Key to *Marasmius* of Peninsular Malaysia**

1. Collarium present, stipe insititious..... (sect. *Marasmius*) 2
- 1.\* Collarium absent, stipe insititious or non-insititious ..... 14
2. Pileipellis composed of *Rotalis*-type broom cells ..... (subsect. *Marasmius*) 3
- 2.\* Pileipellis composed of *Siccus*-type broom cells ..... (subsect. *Sicciformes*) 6
3. Pileus grayish orange, yellowish brown or light brown, lacking a dark papilla ..... 4
- 3.\* Pileus beige, pale yellow, or white, with dark papilla..... 5
4. Pileus 4-12 mm diam; lamellae distant (10-13); basidiospore mean  $9.3 \times 4 \mu\text{m}$  ..... 1. *M. tubulatus*
- 4.\* Pileus 2-6 mm diam; lamellae subdistant (11-15); basidiospore mean  $8.8 \times 4.3 \mu\text{m}$  ..... 2. *M. somalomoensis*
5. Pileus < 1mm diam, beige to pale yellow; lamellae distant (8-10)..... 3. *M. diminutivus*
- 5.\* Pileus 1.5-7 mm diam, white; lamellae subdistant (10-14)..... 4. *M. leucorotalis*
6. (from 2) Pileus hispidulous from presence of pileosetae or very long setulae ..... 7
- 6.\* Pileus glabrous to minutely pruinose or velutinous; pileosetae and long setulae absent..... 8
7. Pileosetae  $16-200^+ \mu\text{m}$  long; pileipellis broom cells and cheilocystidia with 2-4 apical setulae; tipe rarely arising from rhizomorphs..... 5. *M. purpureisetosus*
- 7.\* Pileosetae  $26-60 \mu\text{m}$  long; pileipellis broom cells

- and cheilocystidia with numerous (2-20) pical setulae; stipe mostly arising directly from rhizomorphs..... 6. *M. berambutanus*
8. Basidiospores mean length  $\geq 14.7 \mu\text{m}$ , length range 12-20  $\mu\text{m}$ ..... 9
- 8.\* Basidiospores mean length  $\leq 14.2 \mu\text{m}$ , length range 8-14 (-16)  $\mu\text{m}$ ..... 10
9. Lamellae distant (9-11); pileus with dark papilla; basidiospore mean  $18.8 \times 3.7 \mu\text{m}$  ..... 7. *M. brevicollis*
- 9.\* Lamellae subdistant (10-14); pileus lacking a dark papilla; basidiospore mean  $14.7 \times 4.1 \mu\text{m}$ ..... 8. *M. purpureobrunneolus*
10. Pileus orange, yellowish orange or pale yellow overall..... 9. *M. guyanensis*
- 10.\* Pileus brownish orange, grayish orange, light brown, reddish brown or brown ..... 11
11. Stipe arising directly from copious black rhizomorphs..... 10. *M. crinis-equi*
- 11.\* Stipe not arising or rarely arising directly from rhizomorphs..... 12
12. Pileus 0.5-3 mm diam; lamellae remote to distant (6-9); stipe 2-4 mm long; basidiomes on bamboo leaves..... 11. *M. kuthubutheenii*
- 12.\* Pileus 2-8 mm diam; lamellae distant (6-13); stipe 5-23 mm long; basidiomes on dicotyledonous and monocotyledonous leaves, including bamboo..... 13
13. Pileipellis with many thick-walled, darkly pigmented broom cells that have lumpy or warted setulae 5-12 mm long 12. .... *M. gracilichorda*
- 13.\* Pileipellis with thinner-walled broom cells that have smooth setulae 2-5  $\mu\text{m}$  long..... 13. *M. rufotula*
14. (from 1) Pileipellis composed of a hymeniform layer of clavate to pyriform, non- setulose cells ..... (sect. *Globulares*) 15
- 14.\* Pileipellis composed of *Rotalis*-type or *Siccus*-type broom cells..... 16
15. Pileus grayish brown, brownish orange or grayish orange; basidiospore mean length ca 28  $\mu\text{m}$  ..... 14. *M. aff. camerunensis*
- 15.\* Pileus purplish gray to grayish violet with yellowish white radial stripes; basidiospore mean length ca 25  $\mu\text{m}$ ..... 15. *M. purpureostriatus*
16. Stipe none or rudimentary, lateral to strongly eccentric, less than 2 mm long ..... (sect. *Neosessiles*) 16. *M. tenuissimus*
- 16.\* Stipe central, well-developed. .... 17
17. Pileipellis composed of *Rotalis*-type broom cells ... (sect. *Hygrometrici*) 17. *M. micraster*
- 17.\* Pileipellis composed of *Siccus*-type broom cells 18
18. Lamellae free, well separated from stipe apex; stipe insititious; coarse black rhizomorphs abundant ..... (sect. *Leveilleani*) 18. *M. leveilleanus*
- 18.\* Lamellae attached, typically adnexed to adnate; stipe non-insititious; coarse black rhizomorphs absent ..... (sect. *Sicci*) 19
19. Caulosetae present; stipitipellis with a combination of *Siccus*-type broom cells, setae-like cells with setulae up to 60  $\mu\text{m}$  long and setae; (ser. *Spinulosi*) ..... 19. *M. nummularioides*
- 19.\* Caulosetae absent; stipitipellis lacking caulocystidia or with cylindrical non- setulose caulocystidia or *Siccus*-type broom cells ..... 20
20. Stipe pruinose overall, pruinosity formed from irregularly cylindrical, obtuse to subacute, non-setulose cells, *Siccus*-type cells absent on stipe ..... (ser. *Atrorubentes*) 21
- 20.\* Stipe glabrous or pruinose, if pruinose, then pruinosity formed from *Siccus*-type broom cells 23
21. Pileus light yellow (banana colored); basidiospore mean length 16.1  $\mu\text{m}$ ..... 20. *M. musicolor*
- 21.\* Pileus brownish orange, light brown, reddish brown or brown; basidiospore mean length 10.6-14.1  $\mu\text{m}$  ..... 22
22. Stipe 11-21 mm long; cheilocystidia with only 2-4 setulae up to 20  $\mu\text{m}$  long;  $10.6 \times 3.7 \mu\text{m}$  ..... 21. *M. ochropoides*
- 22.\* Stipe 21-45 mm long; cheilocystidia with numerous, crowded setulae 4-6  $\mu\text{m}$  long; basidiospore mean  $14.1 \times 3.7 \mu\text{m}$ ..... 22. *M. iras*
23. Pleurocystidia absent..... (ser. *Leonini*) 24
- 23.\* Pleurocystidia present, often refractive and conspicuous..... (ser. *Haematocephali*) 42
24. Stipe with caulocystidia (*Siccus*-type broom cells sometimes in combination with small cylindrical to fusoid, non-setulose cells)..... 25
- 24.\* Stipe lacking caulocystidia..... 28
25. Basidiospores  $< 12 \mu\text{m}$  long, mean length range 9.2-11.4  $\mu\text{m}$ ..... 26
- 25.\* Basidiospores  $> 12 \mu\text{m}$  long, mean length range 12.7-17.9  $\mu\text{m}$ ..... 27
26. Pileus pale yellow to pale orange with darker disc; lamellae with non-pigmented edges..... 23. *M. aff. leoninus*
- 26.\* Pileus brownish orange to light brown with darker disc; lamellae with brownish orange edges..... 24. *M. araucariae* var. *siccipes*
27. Pileus orange to pale orange; lamellae with yellow edges; stipe  $< 3.5$  mm long, eccentric; odor none; cheilocystidia irregularly cylindrical, non-setulose. .... 25. *M. luteomarginatus*
- 27.\* Pileus brownish orange to orangish red with darker disc; lamellae with orangish red edges; stipe  $> 16$

- mm long, central; odor like jasmine tea; cheilocystidia of *Siccus*-type broom cells .....  
..... 26. *M. jasminodorus*
28. Basidiospore length in the range 8-14  $\mu\text{m}$  with mean length 9.9-12.7  $\mu\text{m}$  ..... 29
- 28.\* Basidiospore length in the range 12-30  $\mu\text{m}$  with mean length 14.4-27  $\mu\text{m}$  ..... 32
29. Lamellae crowded (24-40), very narrow; pileus 18-50 mm diam, yellowish brown to grayish orange or light brown with a black disc .....  
..... 27. *M. angustilamellatus*
- 29.\* Lamellae subdistant to distant (10-20); pileus 3-18 mm diam, olive, reddish brown to brown or cinnamon-ochraceous to pinkish fulvous ..... 30
30. Pileus olive to olive-brown; basidiospore length in the range 11-14  $\mu\text{m}$  with mean 12.7  $\mu\text{m}$  .....  
..... 28. *M. olivascens*
- 30.\* Pileus reddish brown to brown or cinnamon-ochraceous to pinkish fulvous; basidiospore length in the range 9.5-12  $\mu\text{m}$  with mean 10.4-10.7  $\mu\text{m}$  31
31. Pileus reddish brown to brown, 3-6 mm diam, striate in age; lamellae close to subdistant (10-12).  
..... 29 *M. florideus*
- 31.\* Pileus cinnamon-ochraceous to pinkish fulvous, typically >10 mm diam, smooth in age; lamellae close to crowded (17-20).....  
..... 34. *M. abundans* var. *campanulatus*
32. Basidiospore length in the range 12-18  $\mu\text{m}$  with mean length 14.4-16.9  $\mu\text{m}$  ..... 33
- 32.\* Basidiospore length in the range 16-30  $\mu\text{m}$  with mean length 17.7-27  $\mu\text{m}$  ..... 36
33. Lamellae crowded (16-25 with 3-4 series of lamellulae); basidiospore mean length 14.4  $\mu\text{m}$ ; setulae on cheilocystidia and pileipellis broom cells up to 13  $\mu\text{m}$  long ..... 30. *M. acerorus*
- 33.\* Lamellae close to subdistant (12-19); basidiospores mean length 15.4-16.9  $\mu\text{m}$ ; setulae on cheilocystidia and pileipellis broom cells up to 7  $\mu\text{m}$  long ..... 34
34. Lamellae subdistant (12-13); pileus 1.5-5 mm diam, striate to sulcate in age ..... 31. *M. bambusiniformis*
- 34.\* Lamellae close (14-19); pileus 8-30 mm diam, smooth to striatulate in age..... 35
35. Pileus grayish orange to golden yellow, brownish yellow or ferruginous .....  
..... 32. *M. abundans* var. *abundans*
- 35.\* Pileus orange to deep orange.....  
..... 33. *M. abundans* var. *aurantiacus*
36. Basidiospore length in the range 16-24  $\mu\text{m}$  with mean length 17.7-21.8  $\mu\text{m}$  ..... 37
- 36.\* Basidiospore length in the range 20-30  $\mu\text{m}$  with mean length 24.8-27  $\mu\text{m}$  ..... 40
37. Pileus light orange to light pinkish tan or peach-colored..... 38
- 37.\* Pileus more deeply pigmented, brownish yellow, brownish orange, brown or dark brown ..... 39
38. Pileus 3-10 mm diam; lamellae 8-16; basidiospore mean length 17.7-18.3  $\mu\text{m}$  ..... 35. *M. persicinus*
- 38.\* Pileus 10-43 mm diam; lamellae 12-18; basidiospore mean length 19-21.8  $\mu\text{m}$  .....  
..... 36. *M. corneri*
39. Pileus 10-23 mm diam, brown to dark brown with pinkish tones, gradually becoming yellowish brown to pinkish brown or golden brown on the margin with a dark brown disc; basidiospore mean length 20.9  $\mu\text{m}$  ..... 37. *M. selangorensis*
- 39.\* Pileus 2-12 mm diam, brown to brownish orange with pale grayish orange stripes (lacking pinkish tones); basidiospore mean length 19.5  $\mu\text{m}$ .....  
..... 38. *M. kanchingensis*
40. Pileus 4-13 mm diam, blood red to deep brownish purple; basidiospore mean length 27  $\mu\text{m}$  .....  
..... 39. *M. aratus*
- 40.\* Pileus often up to 20 mm or more in diameter, brown, brownish olive or ferruginous; basidiospore mean length 24.8-25.9  $\mu\text{m}$  ..... 41
41. Pileus 7-20 mm diam, brown to ferruginous with a darker disc; lamellae 11-14; basidiospore length range 20-27  $\mu\text{m}$  with mean length 24.8  $\mu\text{m}$  .....  
..... 40. *M. aciebrunneus*
- 41.\* Pileus 6-40 mm diam, brown to brownish olive with a darker disc; lamellae 10-20; basidiospore length range 25-30 with mean length 27.9  $\mu\text{m}$ .....  
..... 41. *M. adhaesus*
42. (from 23) Lamellae distant (7-8); basidiospore mean length 21.4  $\mu\text{m}$ ..... 42. *M. distantifolius*
- 42.\* Lamellae subdistant (12-13); basidiospore mean length 18.2  $\mu\text{m}$  ..... 43. *M. haematocephalus*

## Taxonomy

### *Marasmius* Fr. sect. *Marasmius*, subsect. *Marasmius*

= sect. *Pararotulae* Singer, Sydowia 18: 339. 1965. [Type species: *Marasmius pararotula* Singer]  
= subsect. *Pararotulae* (Singer) Singer, Fl. Neotrop. Monogr. 17: 92. 1976.

1. *Marasmius tubulatus* Petch, Trans. Brit. Mycol. Soc. 31: 42. 1947. (Fig. 3, Plate 1A)

Type: Sri Lanka, Central Prov., Kandy District, Peradeniya, 1 Nov. 1914, Petch 4243 (K).

*Pileus* 4-12 mm diam, broadly conical and truncate to broadly convex or convex with a shallowly depressed disc, striate to sulcate;

surface dry, dull, minutely pruinose; grayish yellow (4B4-5) to grayish orange (5B3-5), yellowish brown (5D5), light brown (6D5-6) or brown (6E6-5) with a central black dot. *Lamellae* adnate to a collarium, distant (10-13), yellowish white, non-marginate or more commonly with light brown marginate edges. *Stipe* 10-32 × 0.5 mm, central, terete, equal, cylindrical, dry, dull, glabrous, insititious, yellowish white to light brown at apex, dark brown to dark brown at base.

*Basidiospores* (7-) 8-10.5 × 3-4.5 (-5) μm, [ $x_{mr} = 8.7-10.3 \times 3.9-4.1 \mu\text{m}$ ,  $x_{mm} = 9.3 \pm 0.6 \times 4 \pm 0.2 \mu\text{m}$ ,  $Q = 1.7-3.3$ ,  $Q_{mr} = 2.2-2.7$ ,  $Q_{mm} = 2.4 \pm 0.1$ ,  $n = 23$  spores per 9 collections], ellipsoid, smooth, hyaline, inamyloid. *Basidia* 21-27 × 6-7 μm, 2-spored and 4-spored. *Basidioles* 20-28 × 5-8 μm, fusoid to clavate. *Cheilocystidia* abundant, composed of *Rotalis*-type broom cells; main body 12-27 × 7-18 (-22) μm, subclavate to clavate or subglobose, hyaline, inamyloid, thin-walled or apically thick-walled; divergent setulae 1-3 × 0.5-1 μm, abundant over upper half of cell, cylindrical to conical, subacute to obtuse, light yellowish brown to light brown, weakly dextrinoid. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Rotalis*-type broom cells; main body 10-35 (-41) × (7-)10-26 μm, cylindrical to clavate, subclavate, turbinate or subglobose, rarely lobed, hyaline to light yellow, inamyloid, thin-walled or apically thick-walled; divergent setulae 1-4 × 0.5-1 μm, abundant over upper half of cell, cylindrical to conical, subacute to obtuse, brownish yellow to brown, inamyloid, thin-walled. *Pileus trama* interwoven; hyphae 3-6 μm diam, hyaline, inamyloid to weakly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular to subparallel; hyphae 4-8 μm diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipe* tissue monomitic; cortical hyphae 5-10 μm diam, parallel, cylindrical, smooth, yellowish brown to brown, weakly dextrinoid, thick-walled (up to 1 μm), non-gelatinous; medullary hyphae 4-8 μm diam, parallel, cylindrical, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on leaves of undetermined

dicotyledonous trees. Malaysia (Johore), Sri Lanka.

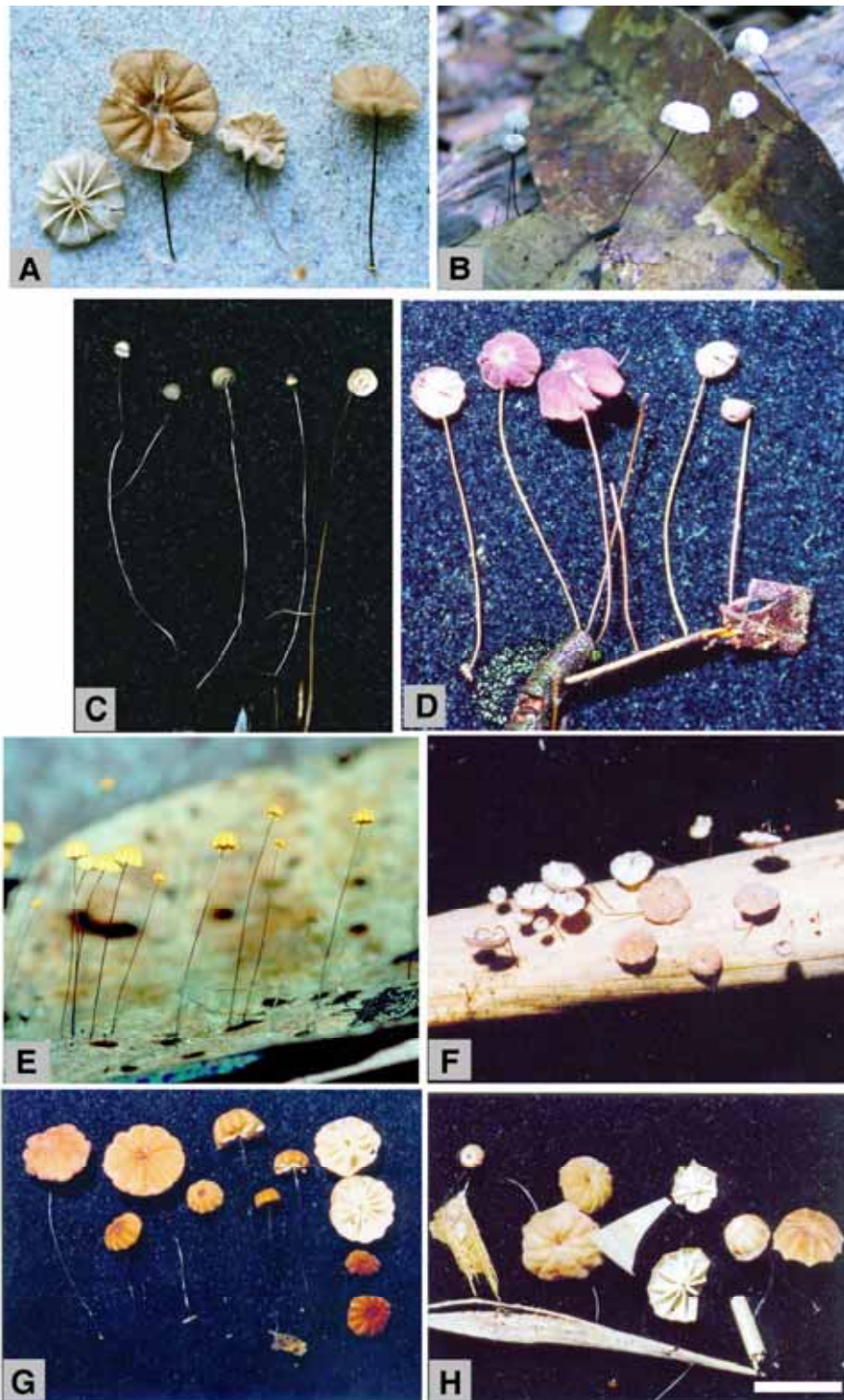
*Material examined:* Malaysia, Johore, Endau Rompin National Park, way to Dato's Ghani Trail + Kuala Jasin, 13 Jul. 2005, Yee-Shin Tan, TYS 492 (KLU-M#109, SFSU); same location, Yee-Shin Tan, TYS 490 (KLU-M#105, SFSU); same location, along the way to NERC, Peta Village and Temiang Trail, 14 Jul. 2005, Yee-Shin Tan, TYS 502 (KLU-M #17, SFSU); same location, 14 Jul. 2005, Yee-Shin Tan, TYS504 (KLU-M #18, SFSU); same location, 14 Jul. 2005, Yee-Shin Tan, TYS 505 (KLU-M #21, SFSU); same location, 14 Jul. 2005, Yee-Shin Tan, TYS 510 (KLU-M #19, SFSU); same location, 14 Jul. 2005, Yee-Shin Tan, TYS 512 (KLU-M #20, SFSU); same location, 14 Jul. 2005, Yee-Shin Tan, TYS 518 (KLU-M #22, SFSU).

*Notes:* *Marasmius tubulatus* is characterized by a light brown or pale yellowish brown pileus with a dark central spot, distant lamellae (10-13) that are non-marginate or have light brown edges, relatively small basidiospores in the range 8-10 × 3-4.5 μm with mean of 9.3 × 4 μm, broad, light brown *Rotalis*-type broom cells on the pileipellis and lamellar edge, and by growth on dicotyledonous leaves. The material from Malaysia differs only subtly from the protologue (Petch, 1947) and redescription (Pegler, 1986) of Sri Lanka specimens, in forming slightly larger pilei (up to 12 mm diam) that are more evenly pigmented and lack a distinct white margin. A tetrapolar (bifactorial) mating system was reported for *M. tubulatus* by Tan *et al.* (2007) based on Malaysian material.

2. *Marasmius somalomoensis* Antonín, Mycotaxon 88: 66. 2003. (Fig. 4)

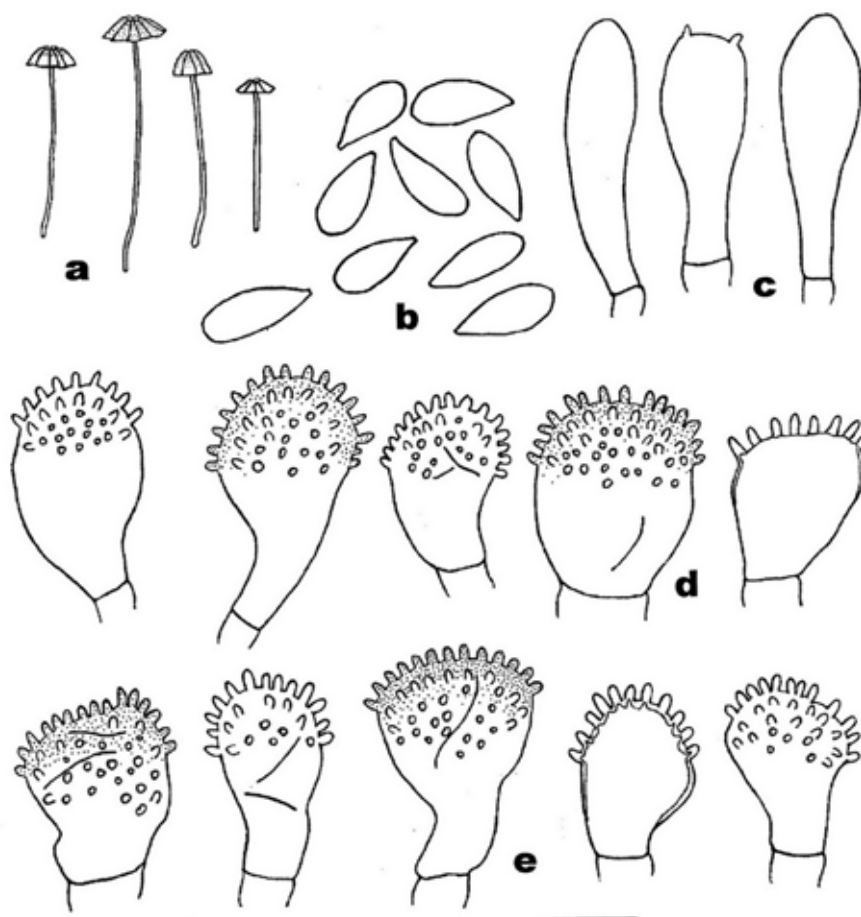
Type: Cameroon, Pud Province, Somalomo, Dja Biospher Reserve, 8 Apr. 2001. (BRNM 666108)

*Pileus* 2-6 mm diam, convex, truncately convex with a shallowly depressed disc, no papilla, striate to sulcate; surface dry, dull, minutely pruinose; yellowish white to light brownish white, golden brown (5E7), grayish orange (6B5), or light brown (6D6), with a central dark brown or black dot. *Lamellae* adnate to a collarium, subdistant (11-15), yellowish white with light brown to brown marginate edges. *Stipe* 10-15 × 0.5 mm, central, terete, equal, cylindrical, dry, dull, glabrous, insititious, yellowish white at apex, dark brown at base.

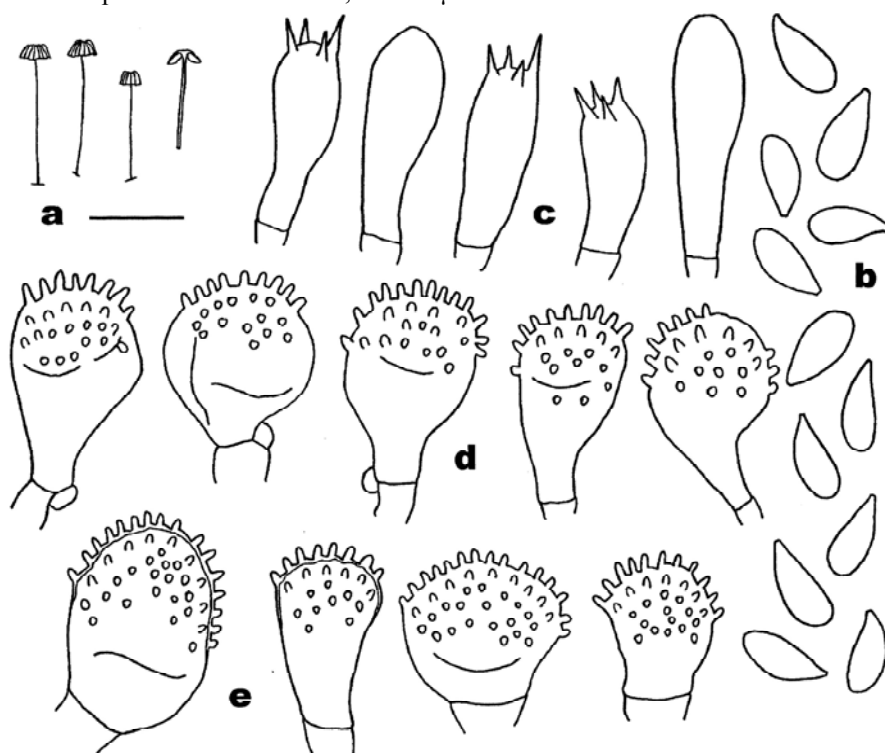


**Plate 1.** *Marasmius* s.s. in section *Marasmius*, subsection *Marasmius* and subsection *Sicciformes*. A: *Marasmius tubulatus* (x 1); B: *Marasmius leucorotalis* (x 1); C: *Marasmius purpureisetosus* (x 1); D: *Marasmius purpureobrunneolus* (x 2); E: *Marasmius guyanensis* (x 1); F: *Marasmius kuthubutheenii* (x 3); G: *Marasmius gracilichorda* (x 2); H: *Marasmius ruforotula* (x 2).





**Fig. 3.** *Marasmius tubulatus* (TYS 502 = KLU-M#17). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.



**Fig. 4.** *Marasmius somalomoensis* (TYS 330 = KLU-M#107). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

*Basidiospores* (7-) 8-10 × 3-4 (-5) µm, [ $x_{mr} = 8.1-9.2 \times 3.6-4.8$  µm,  $x_{mm} = 8.8 \pm 0.5 \times 4.3 \pm 0.5$  µm,  $Q = 1.7-3.3$ ,  $Q_{mr} = 1.9-2.3$ ,  $Q_{mm} = 2.1 \pm 0.2$ ,  $n = 20$  spores per 4 specimens], ellipsoid, smooth, hyaline, inamyloid. *Basidia* 18-23 × 4-7 µm, 4-spored. *Basidioles* 22-25 × 5-7 µm, fusoid to clavate. *Cheilocystidia* abundant, composed of *Rotalis*-type broom cells; main body (12-) 13-20 (-22) × (8-) 10-14 (-15) µm, subclavate to clavate or subglobose, rarely lobed, hyaline, inamyloid, thin-walled or apically thick-walled; divergent setulae 2-3 × 0.5-1 µm, abundant over upper half of cell, cylindrical to conical, subacute to obtuse, light yellow to light brown, inamyloid. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Rotalis*-type broom cells; main body (15-) 17-28 (-34) × (10-) 12-20 (-22) µm, cylindrical to clavate, subclavate, turbinate or subglobose, sometimes lobed, light yellow to light brown, inamyloid, thin-walled or apically thick-walled; divergent setulae 2-3 × 0.5-1 µm, abundant over upper half of cell, cylindrical to conical, subacute to obtuse, yellowish brown to brown, inamyloid, thin-walled. *Pileus trama* interwoven; hyphae 3.5-5 µm diam, hyaline, inamyloid, thick-walled, non-gelatinous. *Lamellar trama* regular to subparallel; hyphae 3-5 µm diam, cylindrical, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-6 µm diam, parallel, cylindrical, smooth, brown, weakly dextrinoid, thick-walled (up to 1 µm), non-gelatinous; medullary hyphae 4-7 µm diam, parallel, cylindrical, smooth, light yellow, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on leaves of undetermined dicotyledonous trees. Africa (Cameroon, DR Congo), Malaysia (Kedah), Thailand.

*Material examined:* Malaysia, Kedah, Langkawi Island, Mt. Raya, N 6°25' 52.8, E 99° 49' 26.5, elev. 652 m, 6 Apr. 2004, Yee-Shin Tan, KUM 60023 (KLU-M#106, SFSU); same location, Matchinchang Forest Reserve, 30 Aug. 2004, Yee-Shin Tan, TYS 330 (KLU-M#107, SFSU); same location, 1 Sept. 2004, Yee-Shin Tan, TYS 335 (KLU-M#108, SFSU); same location, 1 Sept. 2004, Yee-Shin Tan, TYS 336 (KLU-M#130, SFSU).

*Notes:* *Marasmius somalomoensis* was described recently from material collected in Africa. It is distinguished by light brown to

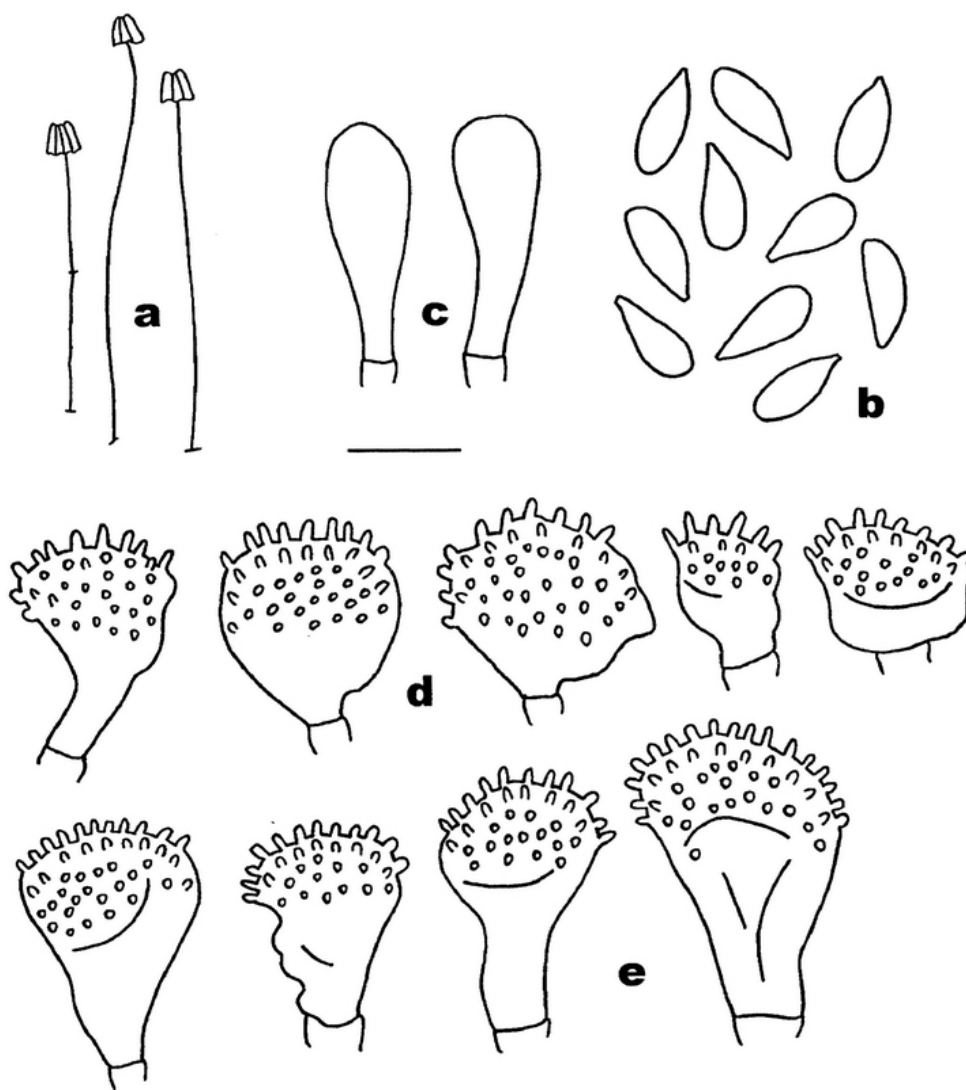
brownish orange, sulcate-depressed pilei 1-5 mm diam, 11-15 collariate lamellae with pale brown edges, basidiospores in the range 7-10 × 3.7-5.5 µm, *Rotalis*-type cheilocystidia (14-30 × 8-18 µm) and pileipellis broom cells (18-33 × 10-19 µm), and growth on dicotyledonous leaves (Antonín, 2007). The Malaysian specimens differ from the protologue of the African material only in having weakly marginate lamellar edges. The species is similar to *M. apatellus* Singer, but this has basidiospores with mean 7.2 × 3.9 µm and non-marginate lamellae. It is also similar to *M. tubulatus* Petch, but the latter forms larger pilei (4-12 mm diam), fewer (10-13) and broader lamellae and slightly narrower basidiospores (mean width 4.0 µm).

3. *Marasmius diminutivus* Y.S. Tan, Desjardin & Vikineswary, **sp. nov.** (Fig. 5) MycoBank: MB512624

*Etymology:* deminutio (Latin) = to make small, diminutive; referring to the tiny basidiomes.

*Pileus* 0.5-1 mm latus, conico-umbilicatus, papilla atrobrunnea conica instructus, striatus vel sulcatus, minutae pruinosis, stramineus vel aurantio-griseus. Lamellae adnato-collariatae, distantes (8-10), stramineae, haud marginatae. Stipes 6-17 × 0.1 mm, filiformis, glabrus, insititius, apicaliter stramineus, basim rubro-brunneus. Basidiosporae 7-9 × 3-4.5 µm, ellipsoideae, leves, hyalinae, inamyloideae. Basidiola 18-20 × 4.5-5 µm, fusiodeae vel clavatae. Cheilocystidia rara, typi *Rotalis*, 12-18 × 11-14 µm, subclavata vel clavata, hyalina; setulae divergentes 1.5-2 × 1 µm, cylindricae vel conicae, obtusae, stramineae. Pleurocystidia nulla. Pileipellis hymeniformis, typi *Rotalis*, cellulae 19-25 × 12-19 µm, subclavatae vel turbinatae, hyalinae, inamyloideae; setulae divergentes 2 × 0.5-1 µm, cylindricae vel conicae, obtusae, stramineae. Caulocystidia nulla. Fibulae presentes. Gregarius, ad folia putrida plantarum dicotyledonearum. Holotypus: Malaysia, Johore, Endau Rompin National Park, 14 Jul. 2005, Yee-Shin Tan, TYS 514 (Holotypus: KLU-M#66).

*Pileus* 0.5-1 mm diam, obtusely conical with narrowly depressed to umbilicate disc, with a tiny, acute papilla in the umbilicus; margin striate to sulcate; surface dry, dull, minutely pruinose; beige to pale yellow or grayish orange (5B3-4) with dark brown papilla. *Lamellae* adnate to a collarium, distant to subdistant (8-10), yellowish white, non-marginate. *Stipe* 6-17 × 0.1 mm, central, terete, equal, filiform, dry, dull, glabrous, insititious, sometimes with a few scattered nodes, orangish white at apex, reddish brown to brown at base.



**Fig. 5.** *Marasmius diminutivus* (Holotype: TYS 514 = KLU-M#66). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 3 mm, b-e = 10  $\mu$ m.

*Basidiospores* (6-) 7-10  $\times$  3-4.5  $\mu$ m, [ $x_{mr}$  = 8-9.3  $\times$  3.5-3.9  $\mu$ m,  $x_{mm}$  = 8.9  $\pm$  0.8  $\times$  3.7  $\pm$  0.2  $\mu$ m, Q = 1.8-2.7,  $Q_{mr}$  = 2.3-2.5,  $Q_{mm}$  = 2.4  $\pm$  0.1, n = 18 spores per 3 specimens], ellipsoid, smooth, hyaline, inamyloid. *Basidia* not observed. *Basidioles* 18-20  $\times$  4.5-5  $\mu$ m, fusoid to clavate. *Cheilocystidia* rare, composed of *Rotalis*-type broom cells; main body (10-) 12-18 (-25)  $\times$  (7-) 11-14  $\mu$ m, subclavate to clavate or subglobose, lobed, hyaline, inamyloid, thin-walled or apically thick-walled; divergent setulae 1.5-2  $\times$  1  $\mu$ m, abundant over upper half of cell, cylindrical to conical, obtuse, light yellow, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* weakly mottled, composed of a hymeniform layer of *Rotalis*-type broom cells; main body (15-) 19-25  $\times$  (9-) 12-19  $\mu$ m, subclavate to turbinate or subglobose, lobed, hyaline, inamyloid, thin-walled or apically

thick-walled; divergent setulae 2  $\times$  0.5-1  $\mu$ m, abundant over upper half of cell, cylindrical to conical, obtuse, light yellow, inamyloid, thin-walled. *Pileus trama* interwoven; hyphae 3-4  $\mu$ m diam, hyaline to light yellow, dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* subparallel; hyphae 3.5-4  $\mu$ m diam, cylindrical, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 3.5-5  $\mu$ m diam, parallel, cylindrical, smooth, yellowish brown, weakly dextrinoid, thick-walled (1  $\mu$ m), non-gelatinous; medullary hyphae 2.5-4.5  $\mu$ m diam, parallel, cylindrical, smooth, hyaline, inamyloid to weakly dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on leaves of undetermined dicotyledonous trees. Malaysia (Johore).

*Material examined:* Malaysia, Johore, Endau Rompin National Park, 14 Jul. 2005, Yee-Shin Tan, TYS 514 (**Holotype:** KLU-M#66; **Isotype:** SFSU); Selangor, Sungai Chongkak Forest Reserve, N 03° 12.705', E 101° 50.472', elev. 188m, 7 Jan. 2005, Yee-Shin Tan, TYS 403 (KLU-M#67, SFSU); same location, 16 May 2005, Yee-Shin Tan, TYS 473 (KLU-M#68, SFSU).

*Notes:* *Marasmius diminutivus* is characterized by the following features: a pileus less than 1 mm diam that is beige to pale yellow with a tiny dark brown papilla; 8-10 collariate lamellae; a wiry stipe 6-17 × 0.1 mm with a few nodes; basidiospores 7-10 × 3-4.5 µm with mean 8.9 × 3.7 µm; *Rotalis*-type cheilocystidia and pileipellis broom cells; and growth on dicotyledonous leaves. It is the smallest *Marasmius* species known from Malaysia and unlike any species described from Malesia. *Marasmius capillaris* Morgan, from eastern North America, differs in forming much larger pilei (2-7 mm diam.), more numerous lamellae (13-18), and a much longer stipe (15-45 mm) (Holotype: ISC!; Desjardin, 1989).

4. *Marasmius leucorotalis* Singer, Sydowia 18: 337. 1965. (Fig. 6, Plate 1 B)

Type: Bolivia, La Paz; Nor-Yungas, Rio Yariza, 23 Feb 1956, Singer B 1414 (LIL).

*Pileus* 1.5-7 mm diam, convex to broadly convex with an umbilicate disc and tiny papilla; margin sulcate; surface dry, dull, minutely pruinose; white with dark brown papilla. *Lamellae* adnate to a collarium, subdistant (10-14), white, non-marginate. *Stipe* 8-35 × 0.5 mm, central, terete, equal, cylindrical, dry, dull, glabrous, insititious, beige at apex, dark brown to black at base.

*Basidiospores* (5-) 6-7 (-7.5) × (2-) 2.5-3 (3.5) µm, [ $x = 6.6 \pm 0.7 \times 2.8 \pm 0.5 \mu\text{m}$ ,  $Q = 2-3.5$ ,  $Q_m = 2.4 \pm 0.4$ ,  $n = 25$  spores per 2 specimens], ellipsoid, smooth, hyaline, inamyloid. *Basidia* not observed. *Basidioles* 18-25 × 5-8 µm, fusoid to clavate. *Cheilocystidia* abundant, composed of *Rotalis*-type broom cells; main body 14-20 (-26) × (9-) 10-16 (-22) µm, subclavate to clavate or subglobose, rarely lobed, hyaline, inamyloid, thin-walled or apically thick-walled; divergent setulae 1-2 × 0.5-1 µm, abundant over upper

half of cell, cylindrical to conical, obtuse, light yellow, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* weakly mottled, composed of a hymeniform layer of *Rotalis*-type broom cells; main body (14-) 16-29 (-37) × 10-17 (-21) µm, subclavate to turbinate or subglobose, rarely lobed, hyaline, inamyloid, thin-walled or apically thick-walled; divergent setulae 1.5-2 (-2.5) × 0.5-1 µm, abundant over upper half of cell, cylindrical to conical, subacute to obtuse, light yellow, inamyloid, thin-walled. *Pileus trama* interwoven; hyphae 3-4 µm diam, hyaline, inamyloid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 4-5 µm diam, cylindrical, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-6 µm diam, parallel, cylindrical, smooth, yellowish brown to brown, weakly dextrinoid, thick-walled (1-2 µm), non-gelatinous; medullary hyphae 4-8 µm diam, parallel, cylindrical, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on leaves of undetermined dicotyledonous trees. Indonesia (Java), Malaysia (Johore), South America (Bolivia).

*Material examined:* Malaysia, Johore, Endau Rompin National Park, Dato's Ghani Trail and trail to Upeh Geling, 12 Jul. 2005, Yee-Shin Tan, TYS 486 (SFSU). Malaysia, Johore, Endau Rompin National Park, Kuala Jasin, 13 Jul. 2005, Yee-Shin Tan, TYS 489 (KLU-M#126, SFSU).

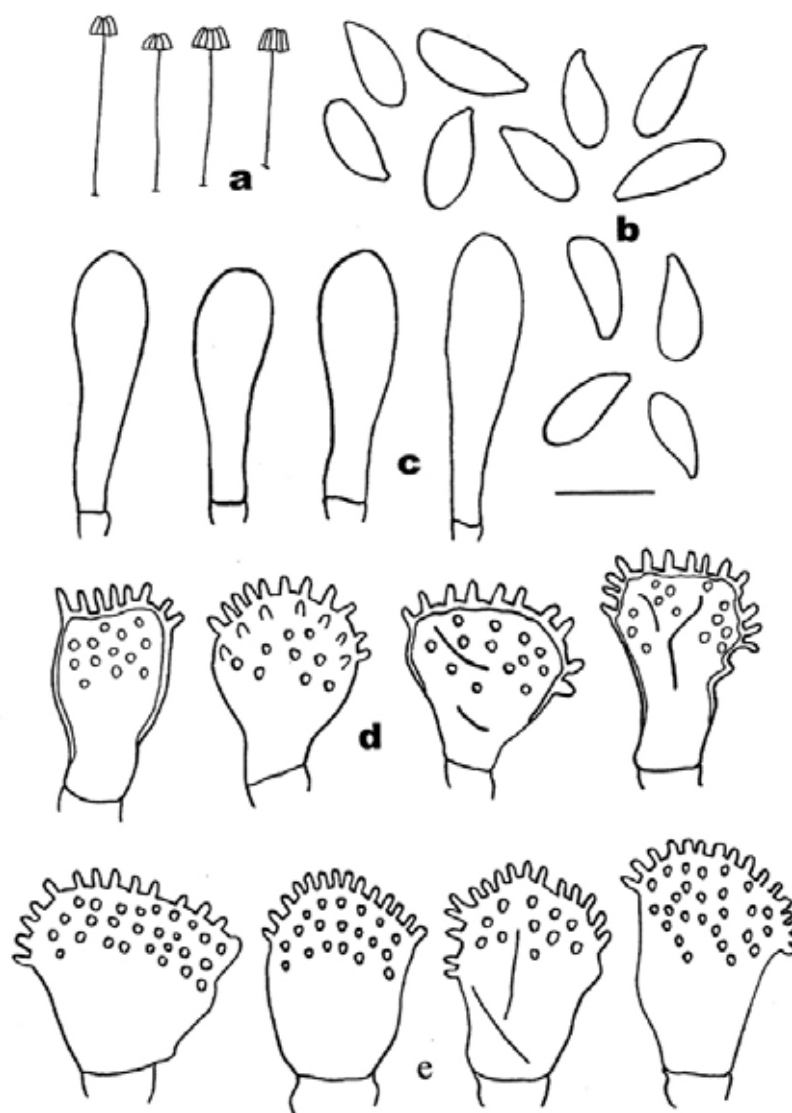
*Notes:* The Malaysian material differs slightly from the Indonesian populations in forming shorter and narrower basidiospores with mean 6.6 × 2.8 µm versus 8.4 × 3.7 µm (Desjardin *et al.* 2000).

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

5. *Marasmius purpleisetosus* Corner, Beih. Nova Hedwigia 111: 90. 1996.

(Fig. 7, Plate 1C)

Type: Malaysia, Johore, Malayan Peninsula, Corner s.n., 1 Sept. 1940 (E#206731!).

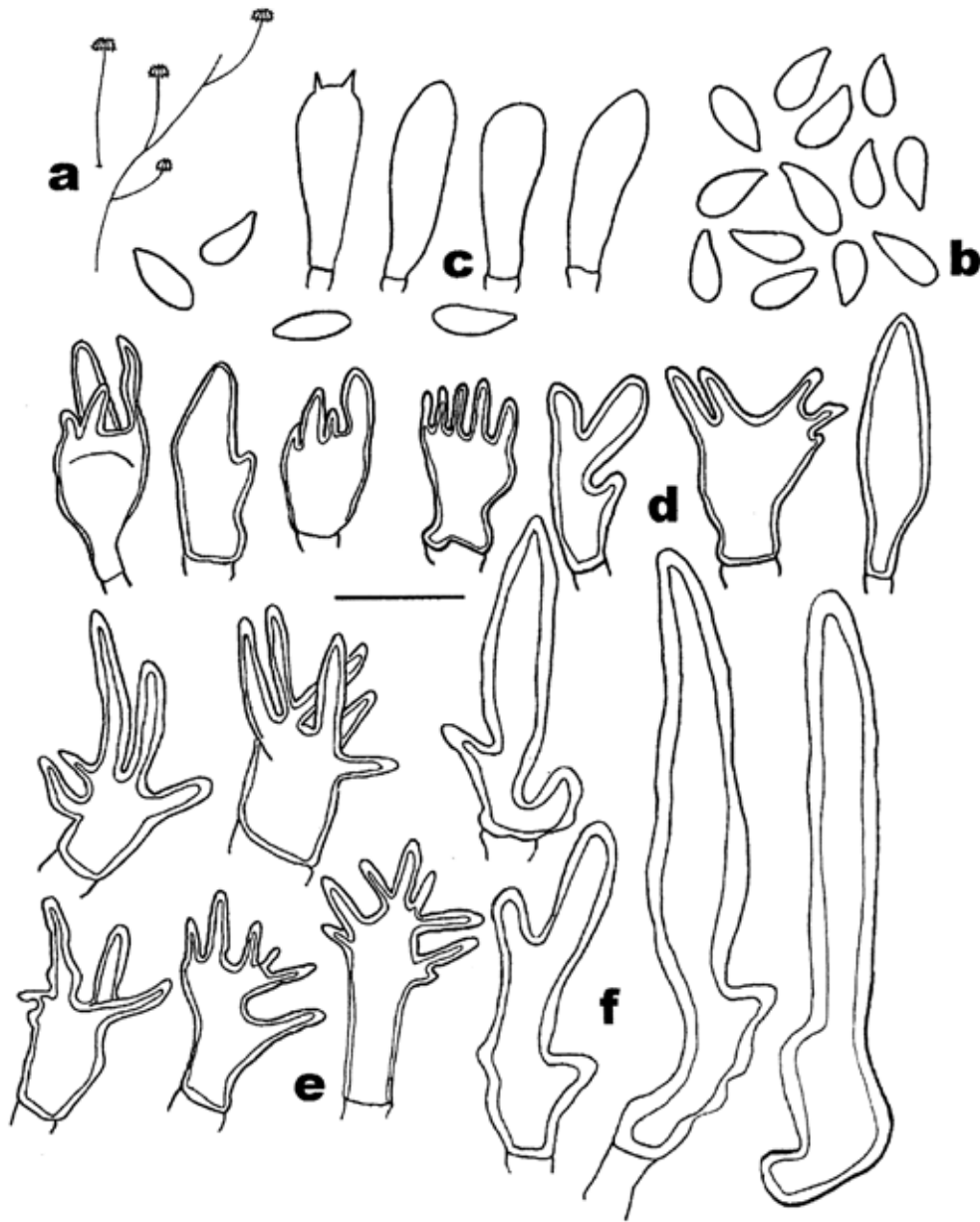


**Fig. 6.** *Marasmius leucorotalis* (TYS 486). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 5 mm, b-e = 10  $\mu$ m.

*Pileus* 0.5-2.5 mm diameter, obtusely conical or conical to convex, with central umbilicus and a small, acute papilla; margin smooth to striate; surface dry, dull, hispid overall with long and brown setae, background colour yellowish brown to grayish orange (5B4), with a pale yellow or light yellow umbilicus. *Lamellae* adnate to a collarium, subdistant to close (7-18), yellowish white, non-marginate. *Stipe* 3.5-10  $\times$  0.1 mm, cylindrical, central, terete, wiry, dry, dull, glabrous, insititious, yellowish brown to dark brown, black rhizomorphs present, some stipes arising from rhizomorphs.

*Basidiospores* (7-) 8-14  $\times$  3-5  $\mu$ m [ $x_{mr}$  = 8.6-12  $\times$  3.5-4.8  $\mu$ m,  $x_{mm}$  = 9.8  $\pm$  1.4  $\times$  4.1  $\pm$  0.5  $\mu$ m, Q = 1.9-3.3,  $Q_{mr}$  = 2.2-2.6,  $Q_{mm}$  = 2.4

$\pm$  0.2, n = 22-35 spores per 7 specimens], ellipsoid, hyaline, smooth, inamyloid. *Basidia* 20-28  $\times$  4-6  $\mu$ m, clavate, 4-spored. *Basidioles* 21-25  $\times$  5-7  $\mu$ m, clavate to fusoid. *Pleurocystidia* absent. *Cheilocystidia* numerous, composed of 2 types of cells: a) *Siccus*-type broom cells; main body 8-22  $\times$  6-15  $\mu$ m, clavate to broadly clavate, cylindrical or irregular in outline, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae 3-12  $\times$  2-4  $\mu$ m, only 2-4 per cell, cylindrical to conical, subacute to obtuse, light yellow, inamyloid, thick-walled; b) non-setulose cells, 23-46  $\times$  8-10  $\mu$ m, cylindrical to clavate or subclavate, hyaline, inamyloid, thick-walled (-1  $\mu$ m). *Pileipellis* mottled, composed of a hymeniform layer of 2 types of cells and pileosetae: a)



**Fig. 7.** *Marasmius purpureisetosus* (KUM 60018 = KLU-M#114). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. f. Pileosetae. Bars: a = 10 mm, b-e = 10  $\mu$ m.

*Siccus*-type broom cells; main body 7-28  $\times$  6-13  $\mu$ m, turbinate to clavate, broadly clavate or irregular in outline, hyaline, inamyloid, thick-walled; apical setulae 6-20  $\times$  1-4  $\mu$ m, only 2-4 per cell, cylindrical to conical, rarely forked, light yellow, dextrinoid, thick-walled, most cells have long setae; b) *transitional elements*, 15-55  $\times$  7-12  $\mu$ m, cylindrical to clavate, light yellow, dextrinoid, thick-walled with 2-3 apical setulae 8-41  $\times$  4-8  $\mu$ m, cylindrical to conical, subacute, light brown, dextrinoid, thick-walled; c) *pileosetae* 16-200<sup>+</sup>  $\times$  3-13  $\mu$ m, brown, dextrinoid, thick-walled (1-3  $\mu$ m broad). *Pileus trama* interwoven; hyphae 7-9  $\mu$ m diam, hyaline, inamyloid, non-gelatinous. *Lamellar trama* regular; hyphae 2-6  $\mu$ m diam, cylindrical,

hyaline, dextrinoid, thin-walled. *Stipe tissue* monomitic; cortical hyphae 3.5-6  $\mu$ m diam, parallel, cylindrical, smooth, brownish yellow, weakly dextrinoid, thick-walled (0.5-1  $\mu$ m), non-gelatinous; medullary hyphae 3-5  $\mu$ m diam, parallel, cylindrical, smooth, hyaline, inamyloid, thin-walled, gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on leaves. Indonesia (Java), Malaysia (Kedah, Negeri Sembilan, Pahang, Selangor), Singapore, Thailand.

*Material examined:* Malaysia, Kedah, Langkawi Island, Gunung Raya, N 06°22'42.3, E 99° 49'21.5, 640 m elev., 6 Apr. 2004, Yee-Shin Tan, KUM 60018 (KLU-M#114, SFSU); same location, 6 Apr. 2004, Yee-Shin Tan, KUM 60020 (KLU-M#115, SFSU); same location,

6 Apr. 2004, Yee-Shin Tan, KUM 60022 (KLU-M#116, SFSU); Langkawi Island, Lubuk Semilang Forest Reserve, N 06° 21'58.4, E 99° 47'29.6, 59m elev., 8 Apr. 2004, Yee-Shin Tan, KUM 60143 (KLU-M#117, SFSU); Negeri Sembilan, Ulu Bendul Forest Reserve, 23 Oct. 2004, Yee-Shin Tan, TYS 371 (KLU-M#119, SFSU); Pahang, Cameron Highlands, Tanah Rata, Jungle walk no 9 & 9A, 9 Jan. 2004, Yee-Shin Tan, TYS 224 (KLU-M#118, SFSU); Selangor, Kanching Forest Reserve, N 03° 17.958', E 101° 31.15', 110 m elev., 9 Jan. 2005, Yee-Shin Tan, TYS 432 (KLU-M#120, SFSU). Singapore, Johore, 1 Sept. 1940, Corner (**Holotype** E#206731).

*Notes:* Basidiomes of *M. purpureisetosus* have the following features: a small, hispid, yellowish brown to grayish orange or pale yellow pileus covered with dark brown to purplish brown pileosetae, subdistant to close (7-18) lamellae attached to a collarium, and glabrous stipes attached to leafy substrate or directly to rhizomorphs. Our Malaysian material matches quite closely with Corner's protologue and the holotype specimen except for the absence of purple tones on the pilei. In addition, the Malaysian specimen differs from Indonesian material in having narrower lamellae and slightly larger basidiospore mean ( $9.8 \times 4.1 \mu\text{m}$  versus  $7.9 \times 3.7 \mu\text{m}$  in Java material; Desjardin *et al.*, 2000).

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

(Fig. 8)

Type: Indonesia, Java, West Java, Mt. Halimun National Park, loop trail from Cikaniki, 6 Jan. 1999, A. Retnowati 081 (BO!).

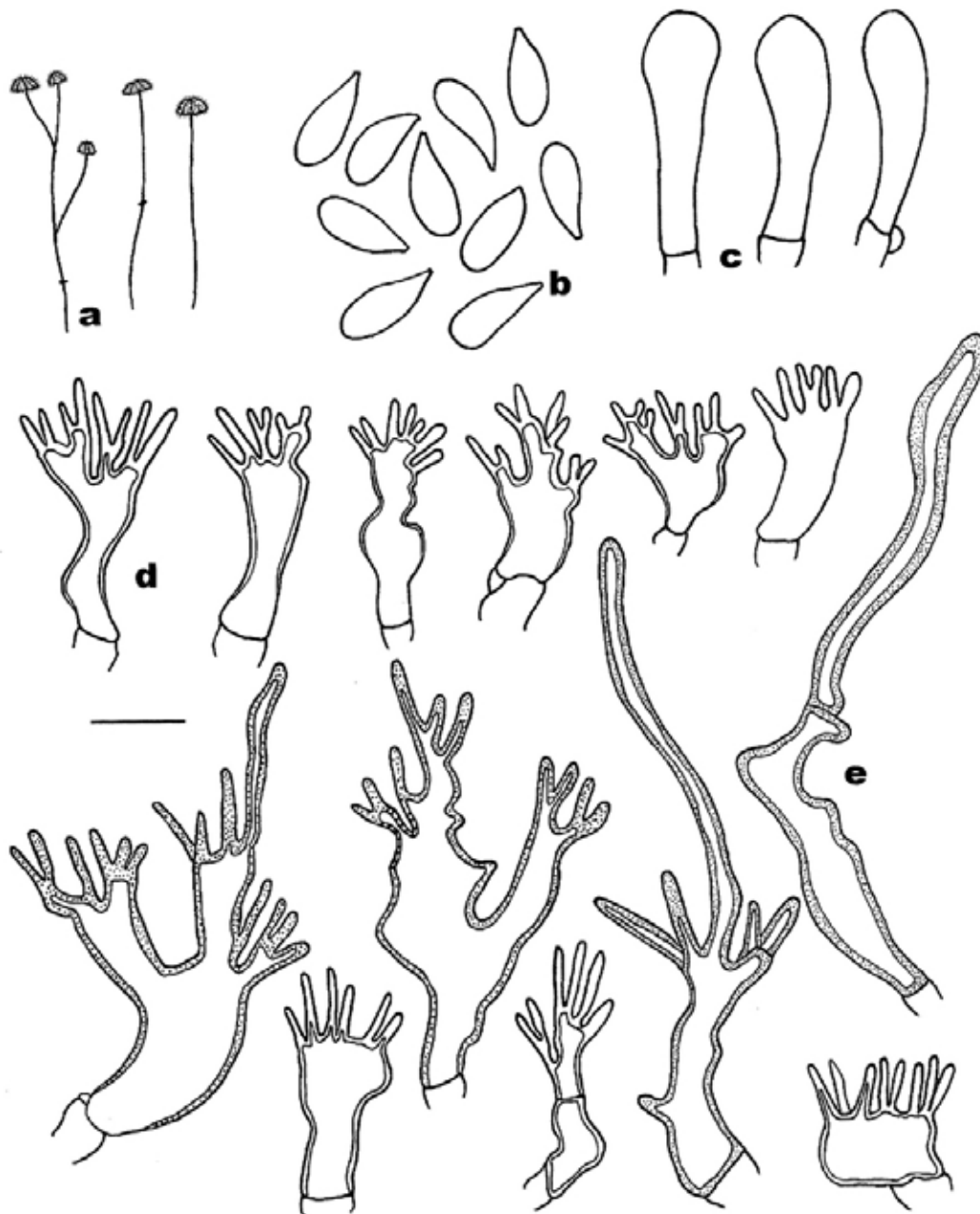
*Pileus* 1-6 mm diam, paraboloid to obtusely conical, convex or broadly convex, umbilicate, with an acute central papilla, sulcate to plicate to the umbilicus; surface dry, dull, minutely velutinous; grayish yellow (4B5) to grayish orange (5B4-5), pale orange or brownish orange (5C5). *Lamellae* adnate to a collarium, distant (7-12) with no lamellulae, broad, pale yellowish white (< 4A2) with grayish orange marginate edges. *Stipe* 3-24  $\times$  0.1 mm, central, terete, equal, filiform, dry, dull, glabrous, insititious, yellowish white at apex, dark brown at base, arising directly from black rhizomorphs; *rhizomorphs* often with scattered nodes.

*Basidiospores* (7-) 8-11 (-12)  $\times$  3-5 (-5.5)  $\mu\text{m}$  [ $x_{\text{mr}} = 8.2-9.5 \times 3.3-4.5 \mu\text{m}$ ,  $x_{\text{mm}} = 9.1 \pm 0.8 \times 4.0 \pm 0.5 \mu\text{m}$ ,  $Q = 1.5-3.3$ ,  $Q_{\text{mr}} = 2.0-2.5$ ,

$Q_{\text{mm}} = 2.3 \pm 0.3$ ,  $n = 30$  spores per 12 collections], ellipsoid, smooth, hyaline, inamyloid. *Basidia* 22-30  $\times$  5-7  $\mu\text{m}$ , clavate, 4-spored. *Basidioles* 18-26  $\times$  5-7  $\mu\text{m}$ , fusoid to clavate. *Cheilocystidia* abundant, composed of *Siccus*-type broom cells; main body 10-20 (-28)  $\times$  5-10 (-13)  $\mu\text{m}$ , subclavate to broadly clavate or subcylindrical, seldom lobed, hyaline, inamyloid, thin- to thick-walled; apical setulae 4-8 (-12)  $\times$  1-2.5  $\mu\text{m}$ , cylindrical to conical, subacute to obtuse, hyaline to light yellow or sometimes pale yellowish brown, inamyloid, thick-walled. *Pleurocystidia* absent. *Pileipellis* weakly mottled, composed of a hymeniform layer of *Siccus*-type broom cells and pileosetae: 1) *Siccus*-type cells with main body 10-24  $\times$  6-13  $\mu\text{m}$ , subclavate to clavate or irregular in outline, often lobed, hyaline to brownish yellow, inamyloid, thick-walled; apical setulae 5-16 (-26)  $\times$  1-2  $\mu\text{m}$ , cylindrical to conical or irregular, subacute to obtuse, light yellow to yellowish brown, inamyloid, thick-walled; 2) *pileosetae* 26-60  $\times$  4-7  $\mu\text{m}$ , filiform to lanceolate or irregular in outline, sometimes branched with apical setulae up to 100  $\mu\text{m}$  long, base often swollen up to 10  $\mu\text{m}$  diam, inamyloid, thick-walled; numerous cells transitional between typical broom cells and setae, with 4-6 simple or forked setulae up to 40  $\mu\text{m}$  long. *Pileus trama* subparallel to interwoven; hyphae 2-6  $\mu\text{m}$  diam, cylindrical, hyaline, inamyloid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 3-7  $\mu\text{m}$  diam, cylindrical, hyaline, inamyloid to weakly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-6  $\mu\text{m}$  diam, parallel, cylindrical, smooth, dark brown, inamyloid, thick-walled (0.5-1  $\mu\text{m}$ ); medullary hyphae 2-5  $\mu\text{m}$  diam, parallel, cylindrical, smooth, hyaline, inamyloid, thin- to thick-walled. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on leaves of undetermined dicotyledonous plants. Indonesia (Java), Malaysia (Johore, Kedah, Kuala Lumpur), Thailand.

*Material examined:* Malaysia, Johore, Endau Rompin National Park, trail to Upeh Geling and trail to Dato's Ghani, 12 Jul. 2005, Yee-Shin Tan, TYS 485 (KLU-M #9, SFSU); same location, 12 Jul. 2005, Yee-Shin Tan, TYS 487 (KLU-M #10, SFSU); Johore, Endau



**Fig. 8.** *Marasmius berambutanus* (TYS 485 = KLU-M#9). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10 µm.

Rompin National Park, Kuala Jasin, 13 Jul. 2005, Yee-Shin Tan, TYS 493 (KLU-M #12, SFSU); same location, 13 Jul. 2005, Yee-Shin Tan, TYS 496 (KLU-M #13, SFSU); same location; 13 Jul. 2005, Yee-Shin Tan, TYS 499 (KLU-M#133, SFSU); same location, Peta village, 14 Jul. 2004, Yee-Shin Tan, TYS 503 (KLU-M#45, SFSU); Kedah, Langkawi Island, Matchinchang Forest Reserve, 1 Sept. 2004, Yee-Shin Tan, TYS 337 (KLU-M #11, SFSU); Kuala Lumpur, MNS heritage trail, 6 May 2004, Yee-Shin Tan, KUM 60168 (KLU-M #14, SFSU); Selangor, Hulu Langat, Sungai Chongkak Forest Reserve, 7 Jan. 2005, Yee-Shin Tan, TYS 398 (KLU-M#44, SFSU).

*Notes:* *Marasmius berambutanus* was described from material collected from a single site on Mt. Halimun, Java (Desjardin *et al.*,

2000). The tiny, collariate basidiomes with pilosetae and *Siccus*-type pileipellis broom cells with elongated setulae are diagnostic for the species. This is the first report of the species from Malaysia. The Malaysian specimens differ subtly from the Java specimens in forming pilei coloured grayish orange when young and often become darker in age (i.e., more deeply pigmented), and they have up to 12 lamellae per basidiome (versus 7-10 in Java material).

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



7. *Marasmius brevicollis* Corner, Beih. Nova Hedwigia 111: 37. 1996. (Fig. 9 & 10)

Type: Singapore, Corner s.n., 2 Apr. 1941 (E #205870!).

*Pileus* 2-7 mm diam, obtusely conical when young, becoming broadly and truncately conical with an umbilicate disc containing a small fuscous papilla, sulcate to umbilicus; surface dry, dull, minutely velutinous; dark brown (7F8) to reddish brown (8F7-8), paler surrounding the papilla. *Lamellae* adnate to a collarium, distant (9-11), yellowish white with dark brown marginate edges. *Stipe* 15-23 × 0.2-0.5 mm, central, cylindrical, terete, dry, dull, glabrous, insititious, yellowish white at apex, golden yellow (5B7-8) to reddish brown at the base, arising directly from the substrate or rarely from brownish orange rhizomorphs.

*Basidiospores* (16-) 17-20 (-21) × 3-4 (-4.5) μm [ $x = 18.8 \pm 1.4 \times 3.7 \pm 0.4$  μm,  $Q = 4-6.6$ ,  $Q_m = 5.1 \pm 0.7$ ,  $n = 30$  spores], elongate-lacrimoid to fusoid or clavate, smooth, hyaline, inamyloid. *Basidia* 20-30 × 7-10 μm, clavate, 4-spored. *Basidioles* 21-25 × 6-9 μm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body 13-20 (-26) × 6-10 (-17) μm, cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin- to thick-walled; apical setulae 2-5 × 0.5-1 μm, crowded, cylindrical to conical, subacute to obtuse, pale yellowish brown, inamyloid, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer *Siccus*-type broom cells; main body 12-20 × 7-16 μm, cylindrical to clavate, broadly clavate or more commonly irregular in outline, often lobed, hyaline to light yellow, weakly dextrinoid, thin- to thick-walled; apical setulae 2-5 × 0.5-1 μm, cylindrical to conical, pale brown to tawny, weakly dextrinoid, thick-walled. *Pileus trama* subparallel; hyphae 3-6 μm diam, cylindrical, hyaline, weakly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 5-9 μm diam, cylindrical, hyaline, weakly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 5-7 μm diam, parallel, cylindrical, smooth, yellow (apex) to brownish yellow (base), dextrinoid, thick-walled (-2 μm); medullary hyphae 3.5-6 μm diam, parallel, cylindrical, smooth, hyaline, weakly dextrinoid,

thin-walled. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Malaysia (Johore), Singapore, Thailand.

*Material examined:* Malaysia, Johore, Endau Rompin National Park, NERC, Peta Village, on the way to jetty, 14 Jul. 2005, Yee-Shin Tan, TYS 517 (KLU-M #15, SFSU). Singapore, 2 Apr. 1941, Corner s.n. (E #205870).

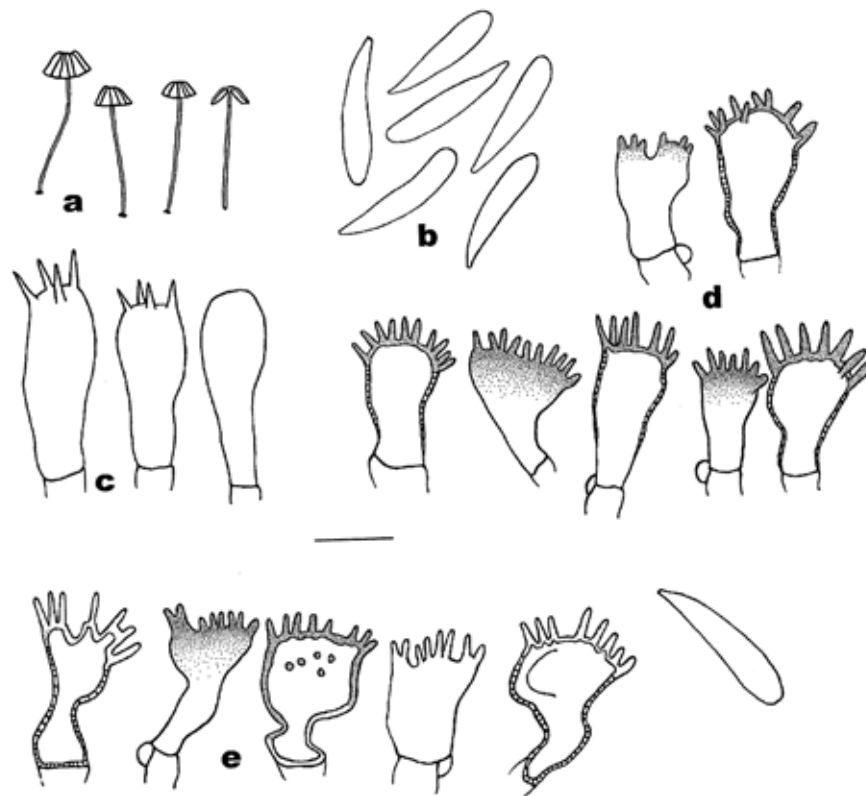
*Notes:* Diagnostic features of this species include: a small sulcate-umbilicate pileus coloured dark brown to reddish brown or fuscous bay with a paler zone in the umbilicus surrounding a small fuscous papilla; collariate lamellae with dark brown edges; a reddish brown stipe; long and narrow, clavate basidiospores in the range 17-20 × 3-4 μm (mean 18.8 × 3.7 μm); and *Siccus*-type cheilocystidia and pileipellis broom cells. *Marasmius brevicollis* differs from *M. purpureobrunneolus* Henn. [= *M. acierufus* Corner (E!)] primarily in forming longer basidiospores and a pileus without purple tones (Desjardin *et al.*, 2000).

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

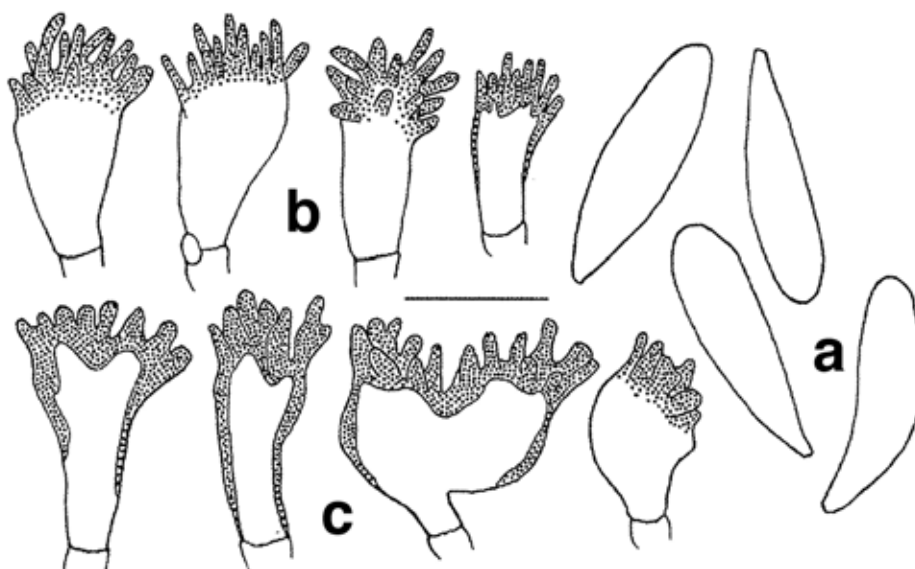
#### Type study of *Marasmius brevicollis*:

The holotype specimen (Corner s.n., 2 Apr. 1941, E #205870) consists of approx. 12 basidiomes, whole or fragmented, in fair condition, attached to dicot leaves. As dried: *Pileus* 1.5-3 mm diam, convex, shallowly umbilicate with a small dark papilla, sulcate, glabrous, deep reddish brown. *Lamellae* narrowly adnate to a narrow collarium, subdistant to distant, broad, cream with cream or slightly darker edges. *Stipe* 15-30 × 0.1 mm, central, filiform, wiry, insititious, glabrous, brown; with numerous hair-like, wiry, dark brown *rhizomorphs*; basidiomes not arising from rhizomorphs.

*Basidiospores* 17-19.2 × 4.0-4.8 μm, clavate to subfusoid, sometimes slightly curved, smooth, hyaline, inamyloid, thin-walled. *Hymenial cells* reviving poorly: no basidia, basidioles or pleurocystidia observed. *Cheilocystidia* abundant, edge sterile, of *Siccus*-type broom cells; main body 9.5-16 × 5-8 μm, clavate to irregular in outline, hyaline, thin-walled or apically thick-walled; apical



**Fig. 9.** *Marasmius brevicollis* (TYS 517 = KLU-M#15). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.



**Fig. 10.** *Marasmius brevicollis* (Holotype: E#205870). a. Basidiospores. b. Cheilocystidia. c. Pileipellis. Bar = 10  $\mu$ m.

setulae 1.5-5 (-6.5)  $\times$  0.5-1.2  $\mu$ m, cylindrical to conical, pale tawny, weakly dextrinoid, thin- to thick-walled. *Pileipellis* weakly mottled, a

hymeniform layer of *Siccus*-type broom cells; main body 7-18  $\times$  6-10  $\mu$ m, cylindrical to clavate or irregular in outline, often lobed,

basally thin-walled to thick-walled, apically thick-walled, hyaline to pale yellowish brown; some cells thicker walled and with fewer more knob-like setulae; apical setulae  $1.2\text{-}5 \times 0.5\text{-}2 \mu\text{m}$ , irregularly cylindrical to knob-like, obtuse, yellowish brown in KOH, weakly dextrinoid, thick-walled. *Stipe cortical hyphae* cylindrical, parallel, smooth, brown, strongly dextrinoid, thick-walled; *medullary hyphae* dextrinoid. *Caulocystidia* absent. *Clamp connections* present.

8. *Marasmius purpureobrunneolus* Henn., *Monsunia* 1: 151. 1900

(Fig. 11 & 12, Plate 1D)

= *Marasmius acierufus* Corner, *Beih. Nova Hedwigia* 111: 25. 1996 (Type: E #205854!)

Type: Java, Bogor Botanical Garden, 12 Feb. 1898, E. Nyman. Not extant.

Neotype: Java, Bogor Botanical Garden, 11 Mar. 1977, E. Horak 77-179 (SFSU!).

*Pileus* 1.5-6 mm diam, convex with distinctly depressed to umbilicate disc, papilla absent; surface dry, dull, pruinose; margin sulcate to plicate; dark brown (8F8), reddish brown (9E7-8) to violet brown (10F8) overall. *Lamellae* adnate to a collarium, subdistant (10-14) with no lamellulae, yellowish white with reddish brown to dark brown edges. *Stipe*  $12\text{-}38 \times 0.5$  mm, central, terete, equal, wiry, tough, solid, dry, dull, glabrous, insititious, pale yellow (3A3) at apex, gradually grading to orange to brownish orange (6B5-6) at the base.

*Basidiospores*  $12\text{-}17$  ( $-19$ )  $\times 3.5\text{-}5 \mu\text{m}$  [ $x = 14.7 \pm 2.3 \times 4.1 \pm 0.7 \mu\text{m}$ ,  $Q = 3\text{-}4.3$ ,  $Q_m = 3.6 \pm 0.4$ ,  $n = 34$  spores], elongate-ellipsoid to fusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia*  $20 \times 5 \mu\text{m}$ , 4-spored. *Basidioles*  $25 \times 6 \mu\text{m}$ , fusoid. Lamellar edge sterile, with a broad band of cheilocystidia; *cheilocystidia* of *Siccus*-type broom cells; main body  $10\text{-}23$  ( $-25$ )  $\times 7\text{-}12$  ( $-15$ )  $\mu\text{m}$ , cylindrical to clavate or vesiculose, rarely lobed, hyaline to yellowish brown, inamyloid to weakly dextrinoid, thin-walled; apical setulae (2-)  $3\text{-}5 \times 0.5\text{-}1 \mu\text{m}$ , crowded, bluntly cylindrical to broadly conical, sometimes forked, light yellow, inamyloid to dextrinoid, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (10-)  $12\text{-}20$  ( $-24$ )  $\times 7\text{-}12$  ( $-14$ )  $\mu\text{m}$ ,

clavate to broadly clavate or irregular in outline, rarely lobed, hyaline, inamyloid to weakly dextrinoid, thick-walled; apical setulae (2-)  $3\text{-}4 \times 1 \mu\text{m}$ , broadly acute, yellow to yellowish brown, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae  $3.5\text{-}5 \mu\text{m}$  diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae  $3\text{-}5 \mu\text{m}$  diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae  $3\text{-}5 \mu\text{m}$  diam, parallel, cylindrical, smooth, yellow, dextrinoid, thick-walled, non-gelatinous; medullary hyphae  $5\text{-}7 \mu\text{m}$ , parallel, cylindrical, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

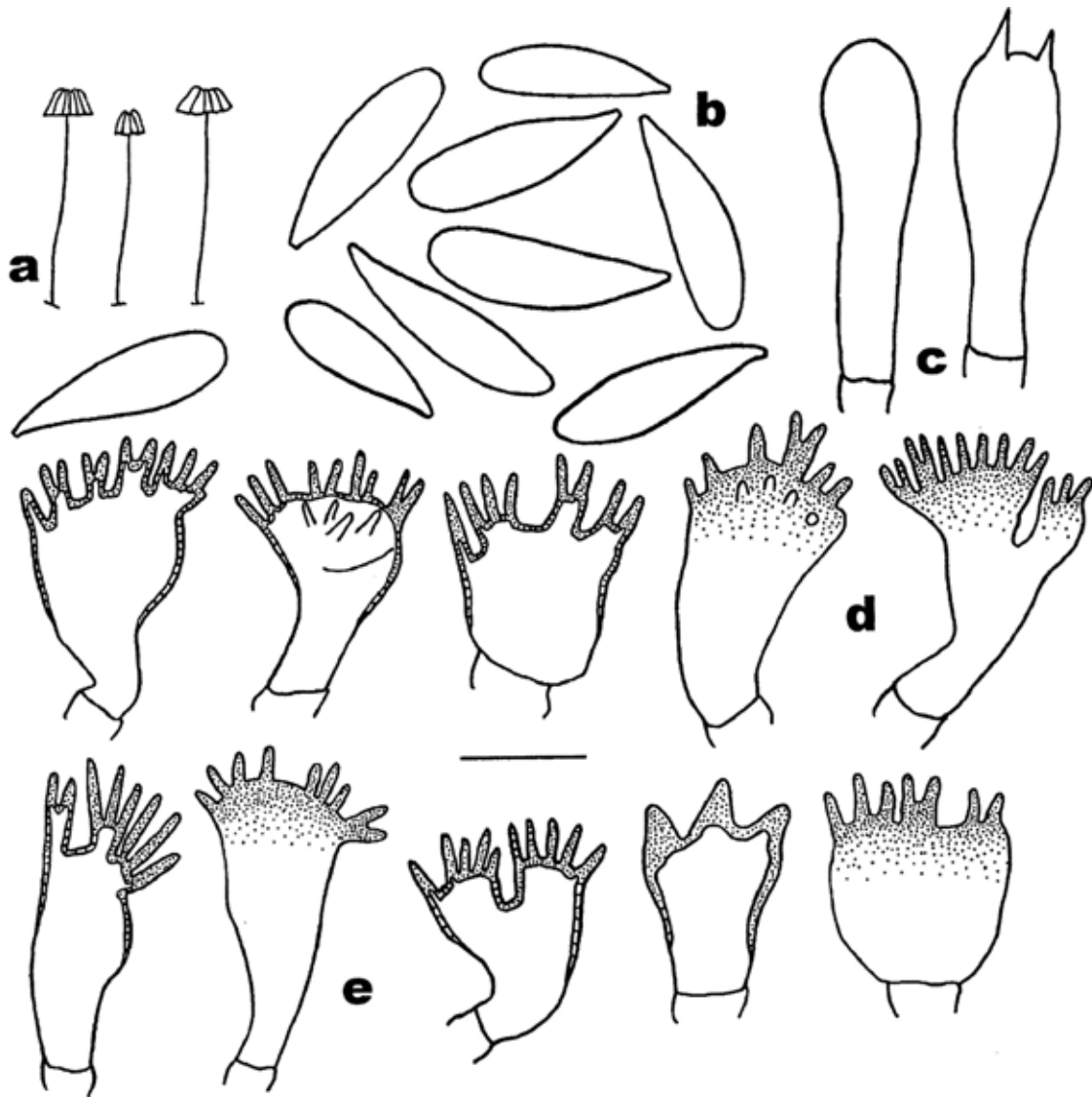
*Habit, habitat and known distribution:* solitary and gregarious on undetermined dicotyledonous leaves and bamboo leaves. Indonesia (Java), Malaysia (Negeri Sembilan), Singapore.

*Material examined:* Malaysia, Johore, Endau-Rompin National Park, Dato's Ghani Trail, 12 Jul. 2005, Yee-Shin Tan, TYS 484 (KLU-M#113); Negeri Sembilan, Ulu Bendul Forest Reserve, 23 Oct. 2004, Yee-Shin Tan, TYS 374 (KLU-M#112, SFSU). Type of *M. acierufus*: Singapore, Botanic Garden, 19 March 1943, Corner s.n. (E #205854).

*Notes:* *Marasmius purpureobrunneolus* is characterized by a small, convex, dark brown to reddish brown or violet brown pileus that lacks a papilla, subdistant (10-14), collariate lamellae with marginated edges, a long, wiry glabrous stipe, relatively short basidiospores ( $12\text{-}17 \times 3.5\text{-}5 \mu\text{m}$  with mean  $14.7 \times 4.1 \mu\text{m}$ ), pigmented broom cells and growth on dicotyledonous leaves. *Marasmius acierufus*, described recently by Corner (1996) from material collected in Singapore, is accepted here as a colour form of *M. purpureobrunneolus*. The protologue of the former reports the pileus as purple rufous to purple madder with the margin becoming cinnamon rufous in age, whereas in *M. purpureobrunneolus* the pileus is more dark purplish brown overall.

**Type study of *Marasmius purpureobrunneolus*:**

For a study of the neotype refer to Desjardin *et al.* (2000).

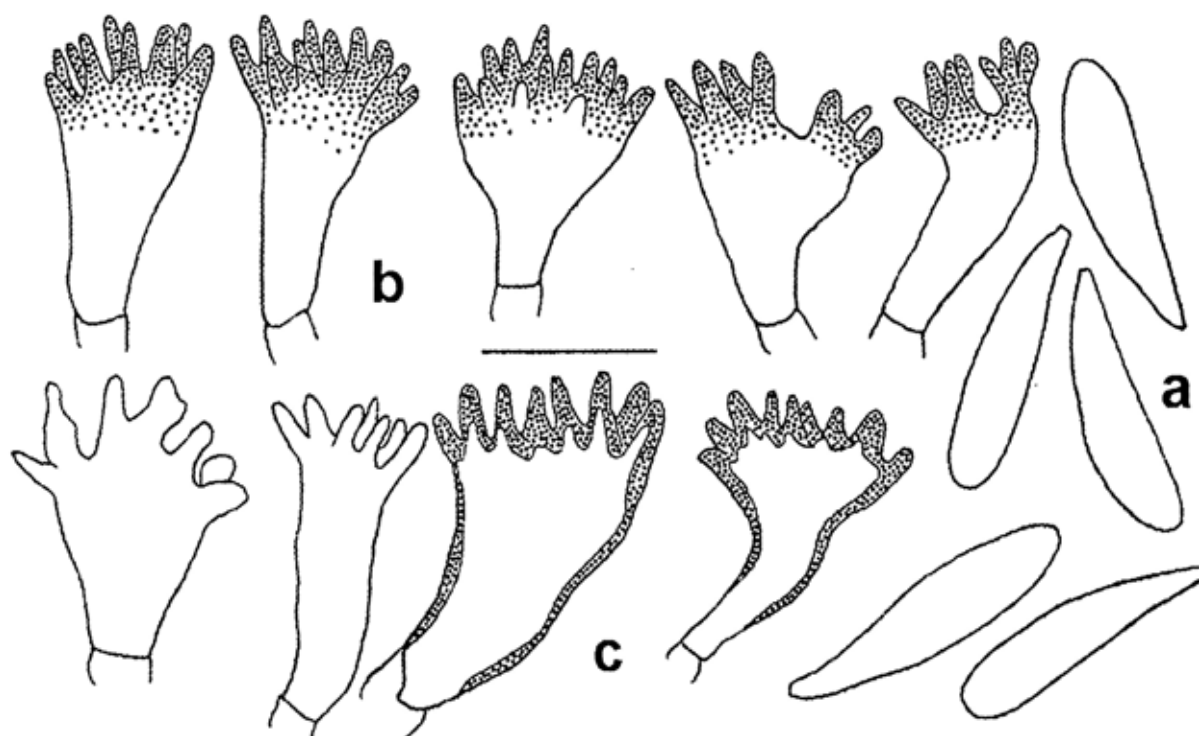


**Fig. 11.** *Marasmius purpureobrunneolus* (TYS 374 = KLU-M#112). a. Basidiomes. b. Basidiospores. c. Basidia and basidiole. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

**Type study of *Marasmius acierufus*:**

The holotype specimen (Singapore, Botanic Garden, Corner s.n., 19 March 1943, E #205854) consists of approx. 16 basidiomes in fair condition, most attached to dicot leaves, rarely to twigs. As dried: *Pileus* 3-5 mm diam, convex, umbilicate, with or without a small papilla, sulcate-plicate, glabrous, dark reddish brown. *Lamellae* adnate to a collarium, distant with no lamellulae, broad, cream, edges concolorous. *Stipe* 15-22  $\times$  0.2 mm, central, terete, filiform, insititious, reddish brown to dark brown; some leaves with wiry, hair-like, glabrous rhizomorphs.

*Basidiospores* 14-17.5  $\times$  3.5-4.5  $\mu$ m, subfusoid to elongate-clavate, sometimes curved, smooth, hyaline, inamyloid, thin-walled. *Basidia* 4-spored, clavate. *Basidioles* clavate to subfusoid. *Cheilocystidia* abundant, edge sterile, of *Siccus*-type broom cells; main body 11-16  $\times$  6-10  $\mu$ m, clavate to pyriform, sometimes lobed, hyaline, thin-walled; apical setulae 1.5-3 (-4)  $\times$  0.8-1.8  $\mu$ m, broadly conical, obtuse to subacute, thin-walled to firm-walled (< 0.5  $\mu$ m), hyaline to pale yellow in KOH. *Pleurocystidia* absent. *Pileipellis* not mottled to weakly mottled, a hymeniform layer of *Siccus*-type broom cells; main body 8-16  $\times$  4.8-12  $\mu$ m, irregularly clavate to pyriform, sometimes



**Fig. 12.** *Marasmius acierufus* (Holotype: E#205854). a. Basidiospores. b. Cheilocystidia. c. Pileipellis. Bar = 10  $\mu$ m.

lobed, thin-walled below, apically thick-walled, hyaline to pale tawny; apical setulae 1.5-3 (-4)  $\times$  0.8-2  $\mu$ m (rather short and broad), broadly conical, sometimes forked, obtuse to subacute, pale tawny, inamyloid, thick-walled. *Pileus trama* and *lamellar trama* regular; hyphae inamyloid. *Stipe cortical hyphae* 3-5  $\mu$ m diam, parallel, cylindrical, brown, strongly dextrinoid, thick-walled; medullary hyphae similar but hyaline, dextrinoid, thin-walled. *Caulocystidia* absent. *Clamp connections* present

9. *Marasmius guyanensis* Mont., Ann. Sci. Nat. Bot. sér. 4, 1: 114. 1854.

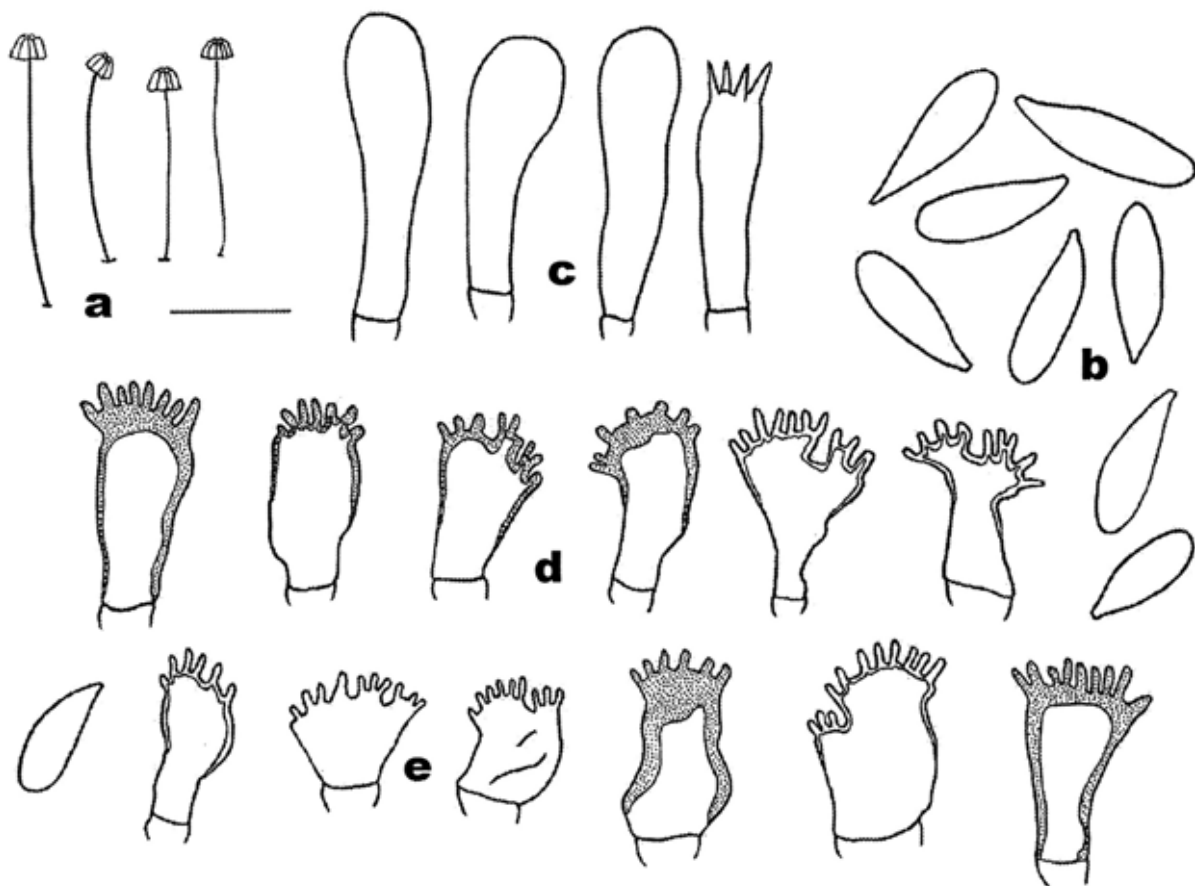
(Fig. 13, Plate 1E)

Type: French Guyana, Leprieur. Authentic specimen, Herb. Berk. (K).

*Pileus* 1-5 mm diam, convex to campanulate, umbilicate, with or without a papilla; margin sulcate to plicate; surface dry, dull, glabrous to minutely pruinose; colour ranging from orange (5A6) to yellowish orange (4A6-7) or pale yellow (3A3) overall with the umbilicus black or brownish orange. *Lamellae* adnate to a collarium, distant to subdistant (8-12) with no lamellulae, not intervenose, broad, yellowish white. *Stipe* 12-23  $\times$  0.1-0.2 mm, central, terete, wiry, dry, dull, glabrous,

insititious, dark brown to black overall; black *rhizomorphs* present.

*Basidiospores* 9-16  $\times$  (2.2-) 3-5  $\mu$ m [ $x_{mr}$  = 10.1-14.2  $\times$  3.3-4.7  $\mu$ m,  $x_{mm}$  = 12.5  $\pm$  1.5  $\times$  3.9  $\pm$  0.4  $\mu$ m, Q = 2.5-5.7,  $Q_{mr}$  = 2.4-4.2,  $Q_{mm}$  = 3.1  $\pm$  0.8, n = 24 spores per 9 specimens] ellipsoid, smooth, hyaline, inamyloid. *Basidia* not observed. *Basidioles* 22-24  $\times$  5-6.4  $\mu$ m, clavate to fusoid. *Pleurocystidia* absent. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body 6-13 (-16)  $\times$  3.8-8  $\mu$ m, clavate to subclavate, cylindrical or irregular in outline, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae 1.6-3.2  $\times$  0.6-1.3  $\mu$ m, crowded, cylindrical to conical, obtuse, light yellow, inamyloid to dextrinoid, thick-walled. *Pileipellis* weakly mottled, a hymeniform layer of *Siccus*-type broom cells; main body 6.4-14.4  $\times$  4.8-9.6  $\mu$ m, cylindrical to clavate, broadly clavate or irregular in outline, hyaline, inamyloid, thick-walled; apical setulae 1-3.2  $\times$  0.5-1  $\mu$ m, conical, obtuse to subacute, rarely forked, hyaline to light yellow, inamyloid, thin- to thick-walled. *Pileus trama* interwoven; hyphae 2.6-3.2  $\mu$ m diam, light yellow, inamyloid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae



**Fig. 13.** *Marasmius guyanensis* (TYS 329 = KLU-M#135). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

3.2-4.2  $\mu$ m diam, cylindrical, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 2-3  $\mu$ m diam, parallel, cylindrical, smooth, brownish yellow to brown, inamyloid to weakly dextrinoid, thick-walled, non-gelatinous; medullary hyphae 3-5  $\mu$ m diam, parallel, cylindrical, smooth, hyaline, inamyloid to weakly dextrinoid, thin-walled, gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves and twigs. Africa (Benin, Cameroon, DR Congo, Nigeria, Sierra Leone), Indonesia (Java), Malaysia (Selangor), South America (Brazil, Bolivia, French Guyana, Trinidad, Venezuela), Thailand.

*Material examined:* Malaysia, Johore, Endau-Rompin National Park, Trail to Upeh Guling, 12 Jul. 2005, Yee-Shin Tan, TYS 488 (KLU-M#158); same location, way to Dato's Ghani Trail and Kuala Jasin, 13 Jul. 2005, Yee-Shin Tan, TYS 494 (KLU-M#159); same location, way to NERC, Peta Village and Temiang Trail, 13 Jul. 2005, Yee-Shin Tan, TYS 520 (KLU-M#160); Kedah, Langkawi Island, Matchinchang Forest Reserve, 30 Aug. 2004, Yee-Shin Tan, TYS 329 (KLU-M#135, SFSU); same location, 30 Aug. 2004, Yee-Shin Tan,

TYS 332 (KLU-M#139); same location, 1 Sept. 2004, Yee-Shin Tan, TYS 342 (KLU-M#140); Mount Raya, N 06° 25' 52.8, E 99° 49' 26.5, 652 m elev., 6 Apr. 2004, Yee-Shin Tan, KUM 60017 (KLU-M#143); Lubuk Semilang Forest Reserve, N 06° 21' 55.2, E 99° 47' 26.5, 59 m elev., 8 Apr. 2004, Yee-Shin Tan, KUM 60144 (KLU-M#141); same location, 8 Apr. 2004, Yee-Shin Tan, KUM 60146 (KLU-M#142); same location, 8 Apr. 2004, Yee-Shin Tan, KUM 60147 (KLU-M#144); Kuala Lumpur, MNS heritage trail, 6 May 2004, Yee-Shin Tan, KUM 60167 (KLU-M#150); Selangor, Ulu Gombak, University of Malaya's Field Study Center, 28 Jul. 2003, Yee-Shin Tan, TYS 028 (KLU-M#137, SFSU); same location, 28 Jul. 2003, Yee-Shin Tan, TYS 030 (KLU-M#151, SFSU); same location, 28 Jul. 2003, Yee-Shin Tan, TYS 031 (KLU-M#152); same location, 6 Sept. 2003, Yee-Shin Tan, TYS 080 (KLU-M#153, SFSU); same location, 8 Nov. 2003, Yee-Shin Tan, TYS 215 (KLU-M#154, SFSU); same location, 16 Oct. 2004, Yee-Shin Tan, TYS 349 (KLU-M#155); same location, 16 Oct. 2004, Yee-Shin Tan, TYS 354 (KLU-M#156); same location, 16 Oct. 2004, Yee-Shin Tan, TYS 355 (KLU-M#157); Negeri Sembilan, Ulu Bendul Forest Reserve, 23 Oct. 2004, Yee-Shin Tan, TYS 373 (KLU-M#162, SFSU); same location, 23 Oct. 2004, Yee-Shin Tan, TYS 372 (KLU-M#148); same location, 23 Oct. 2004, Yee-Shin Tan, TYS 375 (KLU-M#149); Selangor, Hulu Langat Sungai Chongkak Forest Reserve, N 03°12.705', E101° 50.472', 188 m elev., 7 Jan. 2005, Yee-Shin Tan, TYS 395 (KLU-M#136, SFSU); same

location, 7 Jan. 2005, Yee-Shin Tan, TYS 401 (KLU-M#145); same location, 7 Jan. 2005, Yee-Shin Tan, TYS 404 (KLU-M#146); Selangor, Selayang, Kanching Forest Reserve, N 03° 17.958', E 101° 37.151', 110 m elev., 8 Jan. 2005, Amy Honan, TYS 407 (KLU-M#161); same location, 9 Jan. 2005, Yee-Shin Tan, TYS 433 (KLU-M#147).

*Notes:* *Marasmius guyanensis* is a widespread, apparently pantropical species distinguished by a small, orange, yellowish orange or pale yellow plicate pileus with or without a central black papilla, collariate lamellae, and an insititious stipe that does not arise directly from rhizomorphs. The Malaysian material differs subtly from that reported in Indonesia is having up to 12 lamellae per basidiome (versus 7-10 lamellae in Java material; Desjardin *et al.*, 2000).

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

10. *Marasmius crinis-equi* F. Muell. ex Kalchbr., Grevillea 8: 153. 1880. (Fig. 14)

= *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* Berk. & Broome 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.

Type: Australia, North Queensland, Rockingham Bay, F. von Mueller (K).

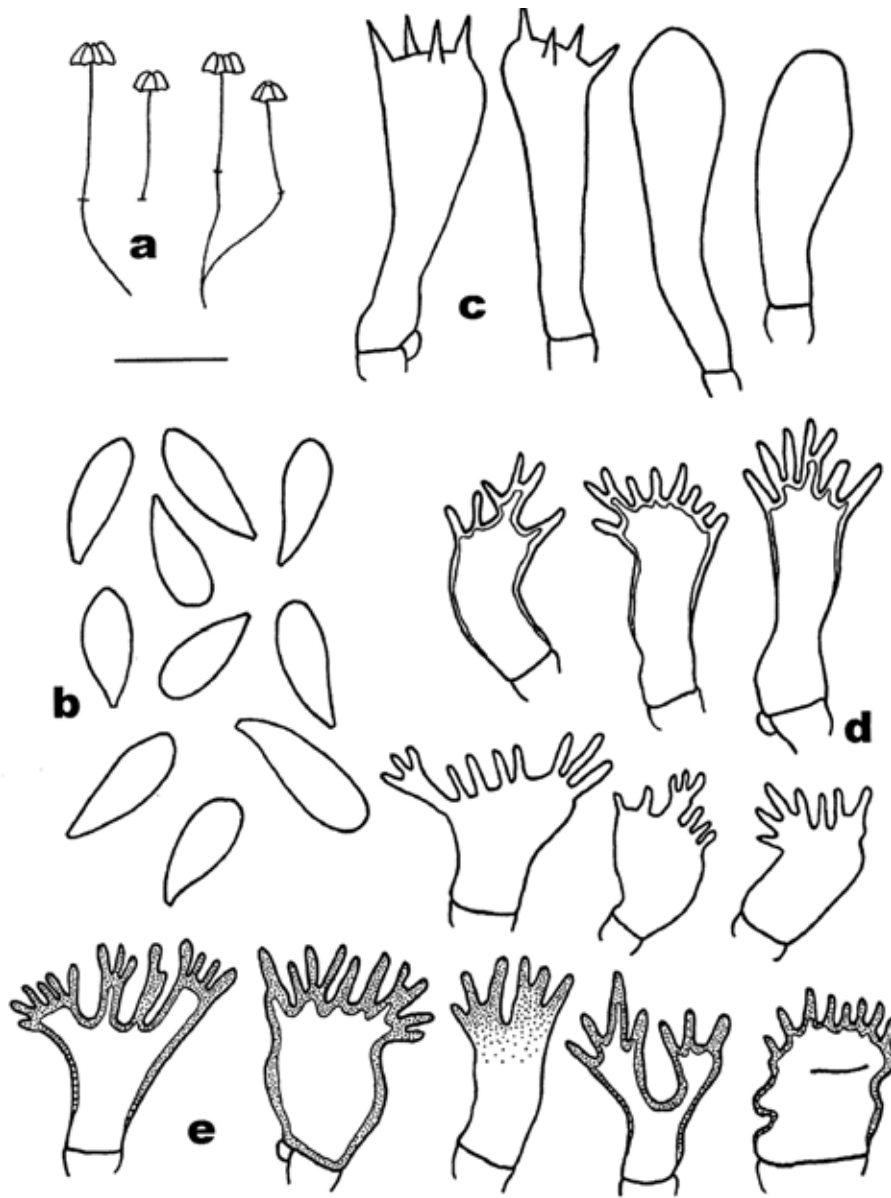
*Pileus* 1-4 mm diam, convex to broadly convex, umbilicate, without a papilla; margin sulcate; surface dry, dull, minutely pruinose; brownish orange (6C8) to grayish orange (5B3). *Lamellae* adnate to a collarium, distant (6-8) with no lamellulae, yellowish white, non-marginate. *Stipe* 4-5 × 0.5 mm, cylindrical, central, terete, wiry, dry, dull, glabrous, insititious, yellowish white at the apex, black at the base, arising directly from wiry, black *rhizomorphs*.

*Basidiospores* (7-) 9-13.5 × 3-4 μm [ $x_{mr} = 8.9-13 \times 3.4-4.5 \mu\text{m}$ ,  $x_{mm} = 10.7 \pm 1.3 \times 3.9 \pm 0.4 \mu\text{m}$ ,  $Q = 1.8-3.3$ ,  $Q_{mr} = 2.4-3.2$ ,  $Q_{mm} = 2.8 \pm 0.3$ ,  $n = 20$  spores per 13 specimens],

ellipsoid, hyaline, smooth, inamyloid, thin-walled. *Basidia* 28-30 × 5-6 μm, fusoid, 4-spored. *Basidioles* 16-25 × 6-7 μm, clavate to fusoid. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (5-) 9-16 (-28) × 5-10 μm, clavate to broadly clavate or cylindrical, rarely lobed, hyaline, inamyloid to weakly dextrinoid, thick-walled; apical setulae (2-) 3-6 × 0.5-1 μm, crowded, rarely forked, cylindrical to conical, obtuse, light yellow, inamyloid to weakly dextrinoid, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, a hymeniform layer of *Siccus*-type broom cells; main body 9-20 × 5-14 μm, clavate to subclavate or irregular in outline, rarely lobed, hyaline to brownish yellow, inamyloid, thick-walled; apical setulae 2-6 × 0.5-1.5 μm, cylindrical to conical, subacute, rarely forked, light yellow to yellow or brown, inamyloid, thin- to thick-walled. *Pileus trama* interwoven; hyphae 3-5 μm diam, hyaline, inamyloid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 5-8 μm diam, cylindrical, hyaline to light yellow, weakly dextrinoid to dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 3-5 μm diam, parallel, cylindrical, smooth, yellowish brown at apex, brown at base, weakly dextrinoid, thick-walled (1 μm); medullary hyphae 3-4 μm diam, parallel, cylindrical, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* solitary on rhizomorph or sometimes on leaves or twigs. Putatively pantropical; Africa, South America, Indonesia (Java), Malaysia (Kedah, Negeri Sembilan, Pahang, Selangor), Sri Lanka, Thailand.

*Material examined:* Malaysia, Kedah, Langkawi Island, Matchinchang Forest Reserve, 1 Sept. 2004, Yee-Shin Tan, TYS 338 (KLU-M#61, SFSU); same location, 1 Sept. 2004, Yee-Shin Tan, TYS 339 (KLU-M#62); same location, 1 Sept. 2004, Yee-Shin Tan, TYS 341 (KLU-M#63, SFSU); Negeri Sembilan, Ulu Bendul Forest Reserve, 23 Oct. 2004, Yee-Shin Tan, TYS 367 (KLU-M#55, SFSU); same location, 23 Oct. 2004, Yee-Shin Tan, TYS 365 (KLU-M#56); same location, 23 Oct. 2004, Yee-Shin Tan, TYS 366 (KLU-M#57, SFSU); same location, 23 Oct. 2004, Yee-Shin Tan, TYS 381a (KLU-M#58); same location, 23 Oct. 2004, Yee-Shin Tan, TYS 382 (KLU-M#59); same location, 23 Oct. 2004, Yee-Shin Tan, TYS 383 (KLU-M#60); Pahang, Fraser's Hill, Kindersley's Trail, 16 Jan. 2004, Yee-Shin



**Fig. 14.** *Marasmius crinis-equi* (TYS 466 = KLU-M#48). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

Tan, TYS 251 (KLU-M#131, SFSU); Selangor, Hulu Langat, Sungai Chongkak Forest Reserve, N 03° 12.705', E101° 50.472', 188 m elev., 16 May 2005, Yee-Shin Tan, TYS 466 (KLU-M#48, SFSU); same location, 7 Jan. 2005, Yee-Shin Tan, TYS 397 (KLU-M#49); same location, 6 Mar. 2005, Yee-Shin Tan, TYS 443 (KLU-M#50, SFSU); same location, 6 Mar. 2005; Yee-Shin Tan, TYS 444 (KLU-M#51); same location, 16 May 2005, Yee-Shin Tan, TYS 459 (KLU-M#52); Selangor, Ulu Gombak, University of Malaya's Field Study Center, 6 Sept. 2003, Yee-Shin Tan, TYS 081 (KLU-M#53); same location, 16 Oct. 2004, Yee-Shin Tan, TYS 361 (KLU-M#54); Selangor, Rawang, Kanching Forest Reserve, N 03°17.958', E 101° 37.151', 110 m elev., 8 Jan. 2005, Yee-Shin Tan, TYS 412 (KLU-M#127, SFSU); same location, 8 Jan. 2005, Yee-Shin Tan, TYS 422 (KLU-M#64); same location, 9 Mar. 2005, Yee-Shin Tan, TYS 447 (KLU-M#65, SFSU).

*Notes:* *Marasmius crinis-equi* is the most common member of the subject. with brownish orange to deep orange, sulcate pilei and basidiomes that arise directly from copious rhizomorphs. The Malaysian populations differ slightly from the Indonesian and Sri Lankan material in typically forming evenly pigmented pilei that lack a papilla and dark central spot. In all other features they are indistinguishable.

11. *Marasmius kuthubutheenii* Y.S. Tan, Desjardin, Vikineswary & Noorlidah **sp. nov.**  
(Fig. 15, Plate 1F)

Mycobank: MB 512635

*Etymology:* Named in honor of Dr. Kuthubutheen who contributed to mycology including applied



mycology research in Malaysia.

Pileus 1-3 mm latus, convexus vel late convexus, papillatus ad centrum, striatus, glaber, brunneo-aurantiacus. Lamellae adnato-collariatae, distantes (6-9), albidae vel pallide stramineae, subbrunneo-marginatae. Stipes 2-4 × 0.2 mm, cylindricus, glaber, insititius, brunneus, rhizomorpha glaber sed haud exoriens. Basidiosporae 7.5-9 × 3-4 μm, ellipsoideae, leves, hyalinae, inamyloideae. Basidia 20-25 × 6 μm, clavatae, 4-spora. Cheilocystidia typi Sicii, abundantia, 8-15 × 6-14 μm, subcylindracea vel clavata, hyalina; setulae ad apicem 3-5 × 0.5-1 μm, cylindricae vel conicae, subacutae vel obtusae, luteae, inamyloideae, crasse-tunicatae. Pleurocystidia nulla. Pileipellis hymeniformis, typi Sicii, cellulae 10-16 × 7-12 μm, clavatae, subclavatae vel irregularia, hyalinae, inamyloideae, crasse-tunicatae; setulae ad apicem 4-8 × 0.5-1 μm, cylindricae vel conicae, subacutae vel obtusae, luteo-brunneae, inamyloideae, crasse-tunicatae. Caulocystidia nulla. Fibulae presentes. Gregarius ad folia putrida bambusarum. Holotypus: Malaysia, Negeri Sembilan, Ulu Bendul Forest Reserve, 23 Oct. 2004, Yee-Shin Tan, TYS 364 (Holotypus: KLU-M#76).

*Pileus* 1-3 mm diam, convex to broadly convex, disc depressed with an acute papilla; margin striate; surface dry, dull, glabrous to minutely pruinose; brownish orange (6C4-5) to light brown (7D5) overall with a brown to black papilla, drying tan to pale brown. *Lamellae* adnate to a collarium, distant (6-9), yellowish white (2A2) with light brown edges. *Stipe* 2-4 × 0.2 mm, central, cylindrical, filiform, dry, dull, glabrous, insititious, yellowish white at apex, brown at base; associated with brown, wiry, glabrous *rhizomorphs* but not arising from them.

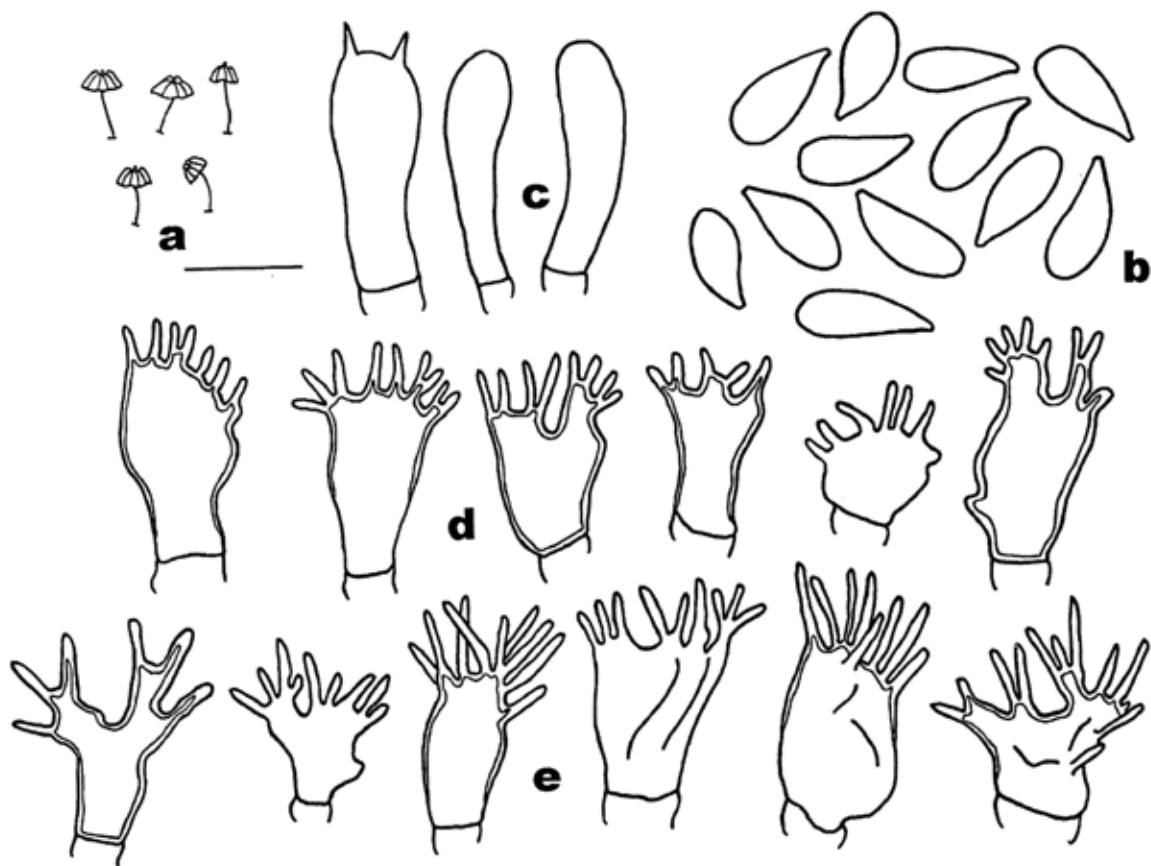
*Basidiospores* 7.5-9 (-10) × 3-4 (-4.5) μm [ $x_{mr} = 7.9-8.7 \times 3.7-3.9 \mu\text{m}$ ,  $x_{mm} = 8.3 \pm 0.6 \times 3.8 \pm 0.1 \mu\text{m}$ ,  $Q = 1.8-3$ ,  $Q_{mr} = 1.6-3$ ,  $Q_{mm} = 2.2 \pm 0.3$ ,  $n = 26$  spores per 2 specimens], ellipsoid, smooth, hyaline, inamyloid. *Basidia* 20-25 × 6 μm, clavate, 4-spored (few observed). *Basidioles* 19-25 × 5-7 μm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body 8-15 (-17) × (5-) 6-14 (-17) μm, clavate to broadly clavate or subcylindrical, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae (2-) 3-5 × 0.5-1 μm, forked, cylindrical to conical, subacute to obtuse, seldom forked, yellow, inamyloid, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (7-) 10-16 × (5-) 7-12 μm, clavate to subclavate or

sometimes irregular in outline, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae (3-) 4-8 × 0.5-1 μm, cylindrical to conical, subacute to obtuse, seldom forked, brownish yellow to dull yellow, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae 3-4 μm diam, cylindrical, hyaline, inamyloid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 5-7 μm diam, cylindrical, hyaline, inamyloid to weakly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 2-5 μm diam, parallel, cylindrical, smooth, yellow at apex, dull yellow at base, dextrinoid to strongly dextrinoid, thick-walled; medullary hyphae 3-4 μm diam, parallel, cylindrical, smooth, hyaline, inamyloid, thick-walled. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on bamboo leaves. Malaysia (Negeri Sembilan, Selangor).

*Material examined:* Malaysia, Negeri Sembilan, Ulu Bendul Forest Reserve, 23 Oct. 2004, Yee-Shin Tan, TYS 364 (**Holotype:** KLU-M#76; **Isotype:** SFSU); Selangor, Ulu Gombak, University of Malaya's Field Study Centre, 16 Oct. 2004, Yee-Shin Tan, TYS 348 (KLU-M#77, SFSU).

*Notes:* *Marasmius kuthubutheenii* is characterized by the following features: a convex-depressed pileus 1-3 mm diam coloured light brown to brownish orange (dries tan to pale brown) with a black papilla; 6-9 collariate lamellae with light brown edges; a short wiry stipe (2-4 × 0.1 mm) that is associated with wiry, glabrous rhizomorphs but does not arise directly from them; basidiospores 7.5-10 × 3-4.5 μm ( $x_{mm} = 8.3 \times 3.8 \mu\text{m}$ ); *Siccus*-type cheilocystidia with narrowly conical, acute setulae 3-5 × 0.5-1 μm; *Siccus*-type pileipellis broom cells with narrowly conical, acute setulae 4-8 × 0.5-1 μm; and growth on bamboo leaves. The new species is phenetically similar to *M. subruforotula* Singer from Africa, *M. aripoensis* (Dennis) Singer from Trinidad, and *M. foliicola* Singer from Argentina. *Marasmius subruforotula* differs in forming larger pilei (3-10 mm diam), more lamellae (up to 12), a longer stipe (7-25 mm), and grows on dicotyledonous leaves. *Marasmius aripoensis* differs in forming a brightly pigmented pileus (deep orangish ferruginous to mahogany red), has more



**Fig. 15.** *Marasmius kuthubutheenii* (Holotype: TYS 364 = KLU-M#76). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

lamellae (7-13), a longer stipe (up to 30 mm), and grows on dicotyledonous leaves. *Marasmius foliicola* differs in forming a larger pileus (4-7 mm diam) coloured more intensely orange, has more lamellae (10-13), and a much longer stipe (15-75 mm); it does, however, grow on bamboo leaves.

12. *Marasmius gracilichorda* Corner, Beih. Nova Hedwigia 111: 57. 1996.

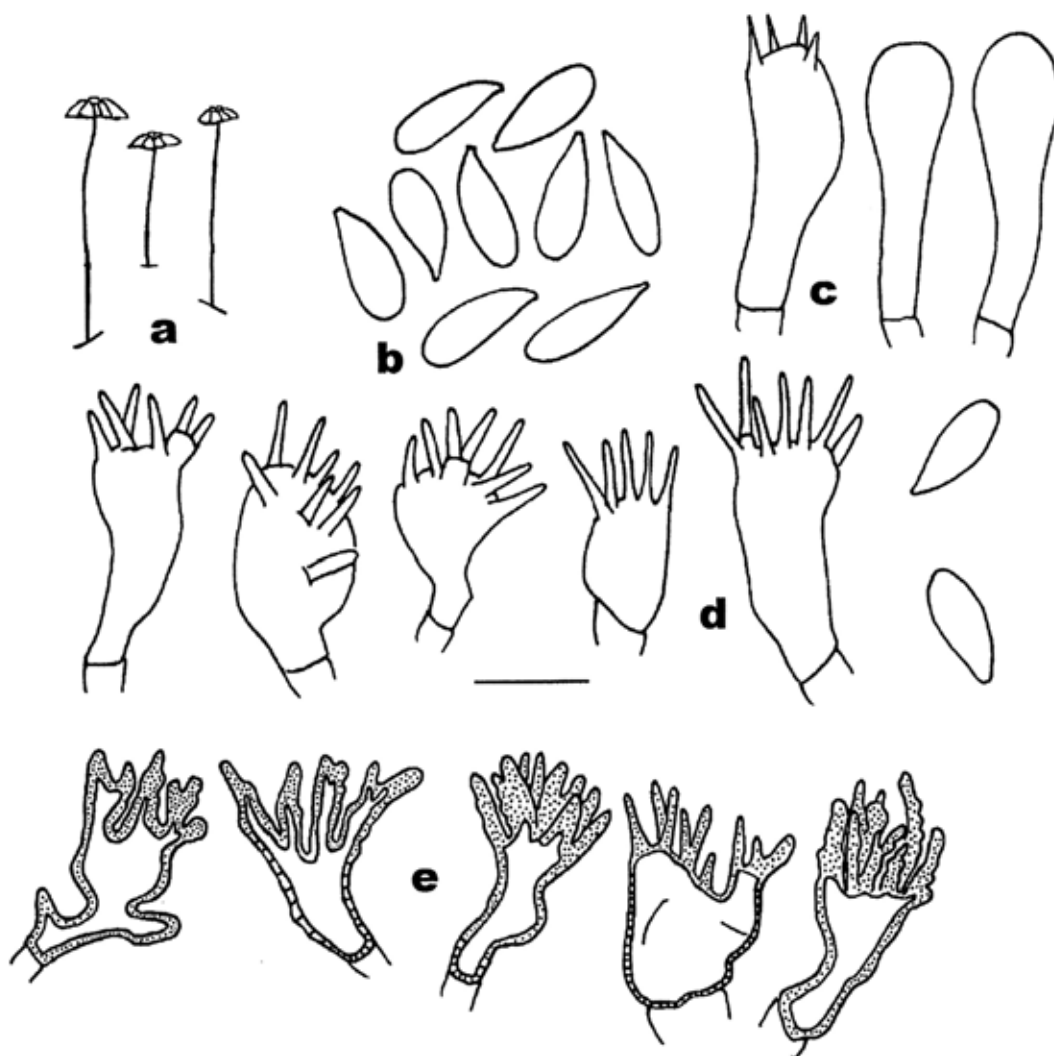
(Fig. 16 & 17, Plate 1G)

Type: Singapore, Gardens Jungle, Corner s.n., 15 Sept. 1940 (E #206712!).

*Pileus* 2-6.5 mm diam, convex, umbilicate, sulcate; surface dry, dull, minutely velutinous; brownish orange (6C7-8, 7C8) to light brown (5D6-7, 7D8), reddish brown (8D8, 8E7) or dark brown (6E8, 8F7-8, 9F8) overall with a tiny black dot in the umbilicus. *Lamellae* adnate to a collarium, distant (6-12), yellowish white (2A2) with brown marginate edges. *Stipe* 8-23  $\times$  0.2 mm, central, cylindrical, filiform, dry, dull, glabrous, insititious, yellowish white at apex, dark brown to black at

base, often associated with fine, dark rhizomorphs.

*Basidiospores* 8-11  $\times$  (3-) 3.5-5  $\mu$ m [ $x_{mr}$  = 9.2-10  $\times$  4-4.6  $\mu$ m,  $x_{mm}$  = 9.6  $\pm$  0.3  $\times$  4.3  $\pm$  0.3  $\mu$ m, Q = 1.8-3.3,  $Q_{mr}$  = 2.1-2.4,  $Q_{mm}$  = 2.3  $\pm$  0.2, n = 30 spores per 5 specimens], ellipsoid, smooth, hyaline, inamyloid. *Basidia* 26-32  $\times$  6-8  $\mu$ m, clavate, 4-spored. *Basidioles* 23-28  $\times$  4-7  $\mu$ m, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body 10-25 (-30)  $\times$  4-12 (-15)  $\mu$ m, subcylindrical to clavate or broadly clavate, rarely lobed, light yellow to light brown, inamyloid, thin-walled; apical setulae 5-8 (-10)  $\times$  0.5-2 (-2.5)  $\mu$ m, crowded, rarely forked, cylindrical to conical, subacute to obtuse, brownish yellow to light brown, inamyloid, thick-walled. *Pleurocystidia* absent. *Pileipellis* strongly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 10-23 (-30)  $\times$  6-12 (-15)  $\mu$ m, turbinate to clavate, broadly clavate or irregular in outline, often lobed, light brown to reddish brown,



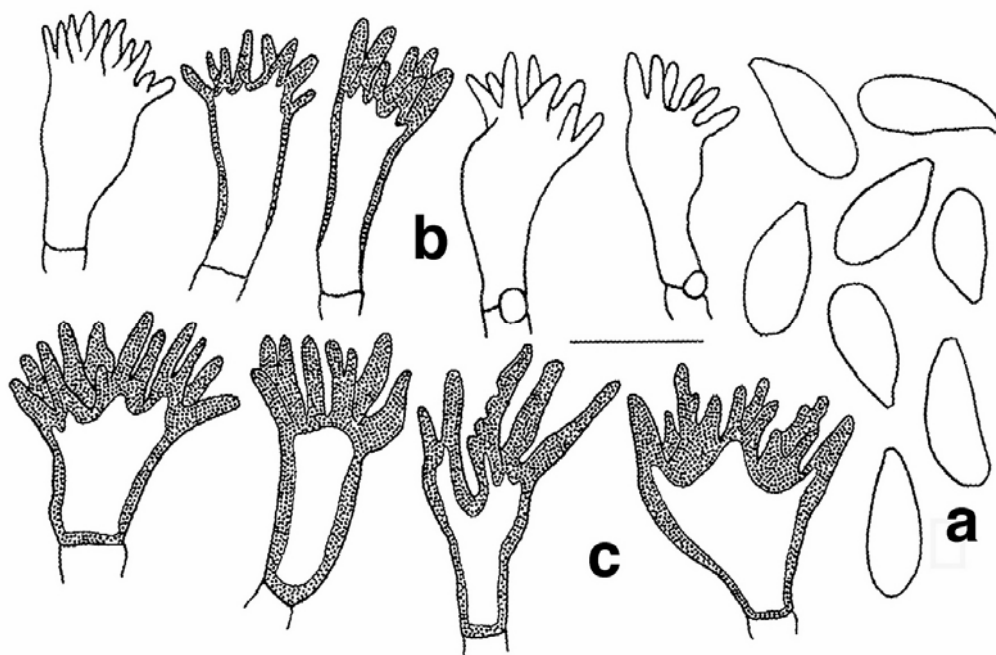
**Fig. 16.** *Marasmius gracilichorda* (TYS 442 = KLU-M#16). a. Basidiomes (x2). b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10 µm.

inamyloid, some thin-walled and with shorter setulae and others thick-walled with longer and more coarsely warted setulae; apical setulae 5-12 (-13)  $\times$  0.5-1.5 (-3)  $\mu\text{m}$ , cylindrical to conical, many warted or lumpy, often forked, brownish yellow to brown, reddish brown or dark brown, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae 3-5  $\mu\text{m}$  diam, cylindrical, hyaline to light yellow, inamyloid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 3-5  $\mu\text{m}$  diam, cylindrical, hyaline, inamyloid to weakly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-6  $\mu\text{m}$  diam, parallel, cylindrical, smooth, brown, inamyloid, thick-walled (-0.5  $\mu\text{m}$ ); medullary hyphae 2-5  $\mu\text{m}$  diam, parallel, cylindrical, smooth, hyaline,

inamyloid, thin-walled. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Malaysia (Pahang, Selangor), Singapore.

*Material examined:* Malaysia, Pahang, Fraser's Hill, Kindersley's Trail, 23 September 2003, Yee-Shin Tan, TYS 190 (KLU-M#132, SFSU); Selangor, Hulu Langat, Sungai Chongkak Forest Reserve, N 03°12.705', E 101°50.472', elev. 122 m, 7 Jan 2005, Yee-Shin Tan, TYS 396 (KLU-M#70, SFSU); same location, 6 Mar. 2005, Yee-Shin Tan, TYS 442 (KLU-M #16, SFSU); same location, 16 May 2005, Yee-Shin Tan, TYS 472 (KLU-M#71, SFSU); Selangor, Selayang, Kanching Forest Reserve, N 03°17.958', E 101°37.151', elev. 110 m, 8 Jan 2005, Yee-Shin Tan, TYS 411 (KLU-M#69, SFSU); Singapore, Gardens Jungle, 15 Sept. 1940, Corner s.n. (**Holotype** E #206712).



**Fig. 17.** *Marasmius gracilichorda* (Holotype: E#206712). a. Basidiospores. b. Cheilocystidia. c. Pileipellis. Bar = 10  $\mu$ m.

*Notes:* The most distinctive feature of *M. gracilichorda* is the pileipellis anatomy. In this species, the pileipellis is mottled, composed of a combination of relatively thin-walled *Siccus*-type broom cells with conical setulae 5-7  $\mu$ m long, and many thicker-walled and more deeply pigmented broom cells with setulae 5-12  $\mu$ m long that are forked or lobed and often lumpy or warted. Corner (1996) described the latter as “antler-like lobulate”. Macroscopically, *M. gracilichorda* looks like *M. ruforotula* Singer, but the characteristic pileipellis of the former clearly distinguishes it.

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

#### **Type study of *Marasmius gracilichorda*:**

The holotype specimen (Singapore, Gardens Jungle, Corner s.n., 15 Sept. 1940, E #206712) consists of approx. 20 basidiomes in good condition, pressed flat and attached to several dicot leaves. As dried: *Pileus* 1.5-3 mm diam, when young with a tall, obtusely conical papilla surrounded by a short skirt, in age the “skirt” expands to become the pileus that is broadly convex, striate to sulcate, with a depression surrounding the central papilla, dull, minutely granulose; papilla brown to dark

brown, elsewhere brownish orange. *Lamellae* adnate to a collarium, subdistant (10-13), no lamellulae, broad, apparently non-marginate. *Stipe* 10-18  $\times$  0.1 mm, filiform, wiry, insititious, glabrous, dark brown to black; with or without fine, wiry, dark brown *rhizomorphs*; basidiomes not arising from rhizomorphs.

*Basidiospores* 8.6-11.2  $\times$  4-5  $\mu$ m, ellipsoid to subfusoid or subclavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* 4-spored. *Basidioles* subfusoid. *Cheilocystidia* abundant, of *Siccus*-type broom cells; main body 10-16  $\times$  4.5-7 (-9.5)  $\mu$ m, clavate, seldom lobed, hyaline, thin-walled or apically thick-walled; apical setulae 2.2-6  $\times$  0.6-1.5  $\mu$ m, irregularly conical, smooth or with scattered warts, thin- to thick-walled, hyaline to pale yellow. *Pleurocystidia* absent. *Pileipellis* not mottled to mottled, a hymeniform layer of *Siccus*-type broom cells; main body 8-18  $\times$  5-12  $\mu$ m, irregularly cylindrical to broadly clavate or irregular in outline, often lobed, hyaline at base, yellowish brown at apex, apically thick-walled or entirely thick-walled (-1.5  $\mu$ m), with scattered very thick-walled cells interspersed; apical setulae 2-10  $\times$  1-1.5(-2.5)  $\mu$ m, irregularly conical, smooth to wavy in outline and often with warts or small branches, yellowish brown, inamyloid, thick-walled. *Tramal hyphae* inamyloid. *Stipe cortical*

hyphae cylindrical, smooth, brown, strongly dextrinoid, thick-walled; medullary hyphae dextrinoid. *Caulocystidia* absent. *Clamp connections* present.

13. *Marasmius ruforotula* Singer, Sydowia 2: 34. 1948. (Fig. 18, Plate 1H)

Type: United States, Florida, Dade Co., Matheson Hammock, 3 Nov. 1942, Singer F 1456 (FH!).

*Pileus* 2-8 mm diam, convex to broadly convex or sometimes plano-convex, disc depressed with an acute papilla; margin striate to sulcate; surface dry, dull, glabrous to minutely velutinous; brownish orange (6C4-5) to reddish brown (7C8) or dark brown (7F8) when young, becoming grayish orange (6B5) to brownish orange (6C6-7) to light brown (7D5) overall with a black papilla at maturity. *Lamellae* adnate to a collarium, distant (8-13), yellowish white (2A2), non-marginate. *Stipe* 5-15 × 0.2 mm, central, cylindrical, terete, equal, dry, dull, glabrous, insititious, yellowish white at apex, brown on the base, associated with black, wiry, tough, black *rhizomorphs* and rarely arising from them.

*Basidiospores* 9-11 (-12) × 4-5 (-6) μm [ $x_{mr} = 8.9-10.5 \times 4.2-5 \mu\text{m}$ ,  $x_{mm} = 9.6 \pm 0.6 \times 4.6 \pm 0.3 \mu\text{m}$ ,  $Q = 1.8-2.7$ ,  $Q_{mr} = 1.5-3.3$ ,  $Q_{mm} = 2.1 \pm 0.1$ ,  $n = 29$  spores per 5 specimens], ellipsoid, smooth, hyaline, inamyloid. *Basidia* 20-28 × 6-10 μm, clavate, 4-spored. *Basidioles* 28-30 × 5-8 μm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body 10-18 (-20) × 7-13 (-15) μm, subcylindrical, clavate to broadly clavate or irregular in outline, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae 2-4 (-5) × 1-2 μm, cylindrical to conical, rarely forked or warted, light yellow, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* weakly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (10-) 11-18 (-27) × 9-15 (-16) μm, turbinate to clavate, broadly clavate, subglobose or subcylindrical, seldom lobed, hyaline, inamyloid, thin- to thick-walled; apical setulae 2-3 (-5) × 0.5-1 μm, cylindrical to conical, subobtuse, seldom forked, light yellow to light brown, inamyloid to weakly dextrinoid, thin-walled. *Pileus trama*

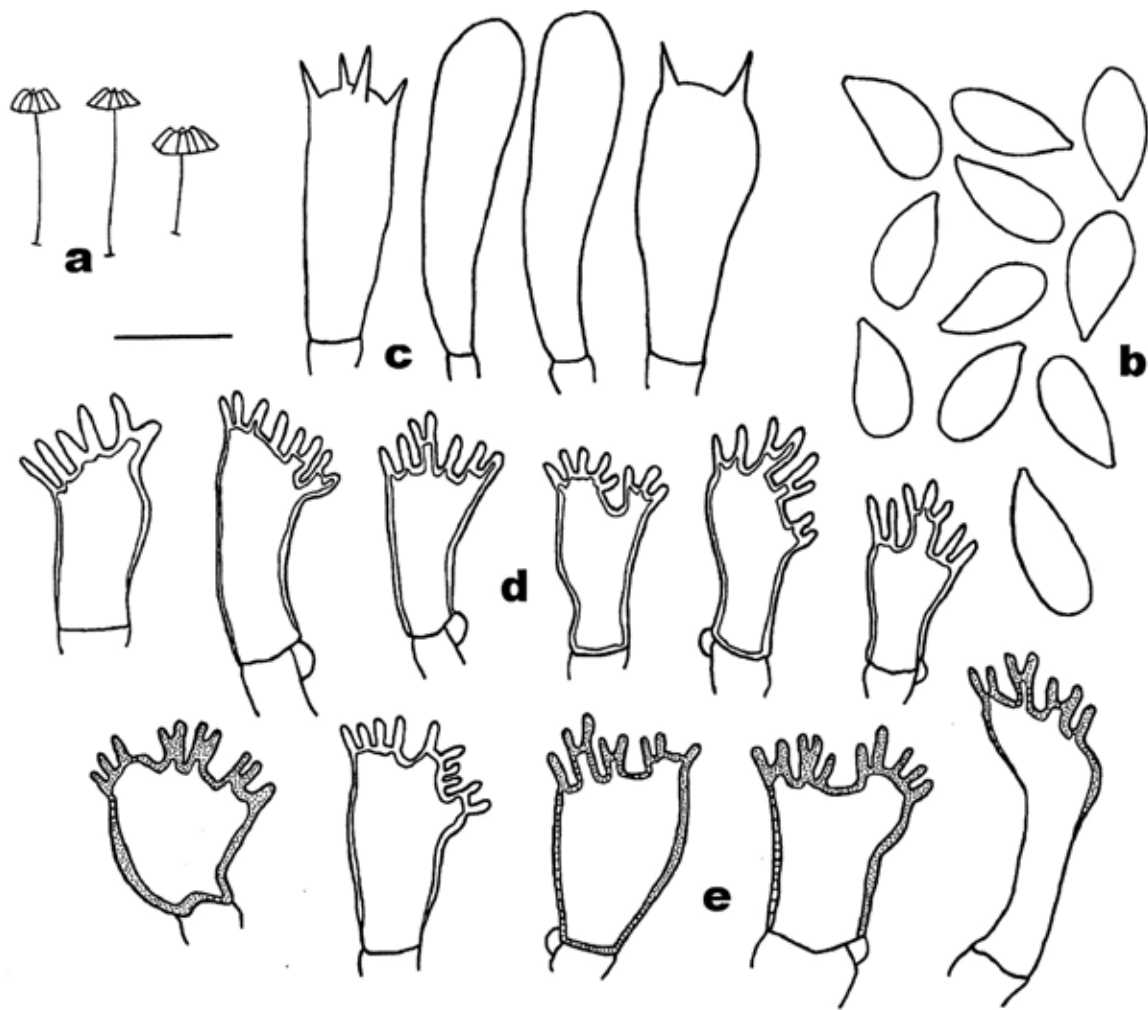
interwoven; hyphae 2.5-5 μm diam, cylindrical, hyaline, inamyloid to weakly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 3-6 μm diam, cylindrical, hyaline, inamyloid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 3.5-5 μm diam, parallel, cylindrical, smooth, brown, weakly dextrinoid, thick-walled; medullary hyphae 3-6 μm diam, parallel, cylindrical, smooth, light yellow, inamyloid, thick-walled (1-2 μm). *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on bamboo and other monocotyledonous leaves. Ecuador, Indonesia (Bali, Java), Malaysia (Selangor), Mexico, Papua New Guinea, Thailand, United States (Florida).

*Material examined:* Malaysia, Johore, Endau-Rompin National Park, 14 Jul. 2005, Yee-Shin Tan, TYS 509 (KLU-M#95, SFSU). United States, Florida, Dade Co., Matheson Hammock, 3 Nov. 1942, Singer F 1456 (**Holotype:** FH!); Negeri Sembilan, Ulu Bendul Forest Reserve, 23 Oct. 2004, Yee-Shin Tan, TYS 369 (KLU-M#93, SFSU); same location, 23 Oct. 2004, Yee-Shin Tan, TYS 370 (KLU-M#96, SFSU); Selangor, Kanching Forest Reserve, N 03°17. 958', E 101°37.151', elev. 110m, 9 Jan. 2005, Yee-Shin Tan, TYS 438 (KLU-M#94, SFSU); Selangor, Ulu Gombak, University of Malaya's Field Study Centre, 16 Oct. 2004, Yee-Shin Tan, TYS 360 (KLU-M#97, SFSU); same location, 28 Nov. 2004, Yee-Shin Tan, TYS 385 (KLU-M#98, SFSU).

*Notes:* *Marasmius ruforotula* is characterized by the following features: a convex-depressed pileus coloured grayish orange to brownish orange or light brown with a dark papilla; 8-13 collariate lamellae with non-marginate edges; and numerous black rhizomorphs. The Malaysian material differs from Indonesian specimens in having slightly larger basidiospores mean (9.6 × 4.6 μm versus 8.9 × 4.3 μm in Java material) and shorter stipe (3-15 × 0.2 mm versus 7-25 × 0.1-0.3 mm in Java material; Desjardin *et al.*, 2000). Basidiospores size in the holotype specimen is nearly identical to that of the Indonesian populations.

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



**Fig. 18.** *Marasmius ruforotula* (TYS 438 = KLU-M#94). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

#### Type study of *Marasmius ruforotula*:

The holotype specimen (United States, Florida, Dade Co., Matheson Hammock, 3 Nov. 1942, Singer F 1456, FH) consists of several basidiomes in good condition. As dried: *Pileus* convex-umbilicate with a small central papilla, striate or sulcate to the central depression, glabrous, deep ferruginous overall (lacking a pale zone surrounding a dark central spot). *Lamellae* adnate to a well-developed collarium, subdistant, broad, pallid, non-marginate. *Stipe* filiform, glabrous, shiny, upper half stramineous, base ochraceous or brown, insititious, lignicolous.

*Basidiospores* 7.5-9.5  $\times$  4-5  $\mu$ m [ $x = 8.6 \pm 0.5 \times 4.3 \pm 0.3 \mu$ m,  $Q = 1.8-2.2$ ,  $Q_m = 2 \pm 0.1$ ,  $n = 20$ ], ellipsoid or sublacrymoid, hyaline, inamyloid, smooth. *Basidia* 20-26  $\times$  5.5-7.5  $\mu$ m, clavate, 4-spored. *Basidioles* cylindrical to

fusoid. *Cheilocystidia* numerous, of *Siccus*-type broom cells; main body 12-16  $\times$  6.5-10  $\mu$ m, clavate, hyaline, thin-walled; apical setulae 2-5  $\times$  1-2  $\mu$ m, cylindrical to subconical, obtuse, thick-walled, hyaline or pale yellow. *Pleurocystidia* absent. *Pileipellis* weakly mottled, a hymeniform layer of *Siccus*-type broom cells; main body 12-20  $\times$  7-12  $\mu$ m, cylindrical to clavate or turbiniate, seldom lobed, many pale yellow or pale orange and thin-walled, many orange or orange-tawny and thick-walled; apical setulae 2-5  $\times$  1-2  $\mu$ m, rod-like, conical or irregular in outline, obtuse, thick-walled and yellowish orange, or solid and orange-tawny to ferruginous. *Pileus trama* interwoven; *lamellar trama* regular; hyphae 3-10  $\mu$ m diam, cylindrical, smooth, non-gelatinous, hyaline, inamyloid or weakly dextrinoid, thin-walled. *Stipe tissue* monomitic; cortical hyphae 3-5.5  $\mu$ m diam, parallel,

cylindrical, smooth, stramineous or tawny, dextrinoid, thick-walled (0.5-1.2  $\mu\text{m}$ ); medullary hyphae similar but hyaline, inamyloid, thinner-walled. *Caulocystidia* absent. *Clamp connections* present.

***Marasmius* sect. *Globulares* Kühner**, *Botaniste* 25: 100. 1944 (*ut* Globularineae).

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

14. ***Marasmius* aff. *camerunensis*** Antonín & Mossebo, *Mycotaxon* 85: 113. 2003.

(Fig. 19, Plate 2A)

Type: Cameroon, Littoral Province, near the village of Poola'a, ca. 5 km from Nkongsamba, 20 Aug. 1998. leg. D.C. Mossebo M196(1) (BRNM 670732).

*Pileus* 16-58 mm diam, convex to plano-convex; disc flat or very slightly broadly depressed in age; margin smooth to striate or radially wrinkled; surface dry, dull, hygrophorous, glabrous; disc and radial wrinkles grayish brown (8D3) to brownish orange (7C3) or grayish orange (6B3), margin pinkish brown. *Context* thin (< 1 mm), tough, light brown. *Lamellae* broadly adnate, distant to subdistant (10-16) with 1-2 series of lamellulae, very broad, pale brownish gray, non-marginate. *Stipe* 45-150  $\times$  2-4 mm, central, cylindrical, terete, equal, tough, pliant to cartilaginous, hollow, dull, dry, glabrous, non-insititious, grayish brown to light brown overall, base covered with yellowish white mycelium. *Odor and taste* not distinctive.

*Basidiospores* (17-) 25-35 (-40)  $\times$  5-7  $\mu\text{m}$  [ $x = 28.4 \pm 6.2 \times 5.8 \pm 0.7 \mu\text{m}$ ,  $Q = 3.3-6.4$ ,  $Q_m = 5.0 \pm 1.0$ ,  $n = 29$  spores], elongate-lacrymoid to clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* 35-52  $\times$  8-10  $\mu\text{m}$ , fusoid to clavate. *Cheilocystidia* common, (17-) 18-26 (-28)  $\times$  (8-) 10-16  $\mu\text{m}$ , subglobose to broadly clavate or subcylindrical, hyaline, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, not mottled, composed of clavate to broadly clavate, pyriform or subglobose cells (11-) 12-20 (-25)  $\times$  (6-) 9-13  $\mu\text{m}$ , hyaline, inamyloid, thin-walled. *Pileus trama* interwoven; hyphae 4.5-8  $\mu\text{m}$  diam, cylindrical, light yellow, dextrinoid, thin-walled (skeletal absent), non-gelatinous.

*Lamellar trama* regular; hyphae 3-5  $\mu\text{m}$  diam, cylindrical, hyaline, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-10  $\mu\text{m}$  diam, parallel, cylindrical, smooth, yellow, dextrinoid, thick-walled, non-gelatinous; medullary hyphae 4-7  $\mu\text{m}$ , parallel, cylindrical, smooth, light yellow, dextrinoid, thick-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution*: gregarious on undetermined dicotyledonous leaves in lowland forest. Cameroon, Malaysia (Kedah).

*Material examined*. Malaysia, Kedah, Langkawi Island, Lubuk Semilang Forest Reserve, N 06° 21.58.4', E 99° 47.29.6', elev. 59 m, 8 Apr. 2004, Yee-Shin Tan, KUM 60134 (KLU-M#46, SFSU); same location, 8 Apr. 2004, Yee-Shin Tan, KUM 60135 (KLU-M#47, SFSU).

*Notes*: Two specimens of this taxon are known from Malaysia. It is most closely allied with *M. camerunensis* from Africa. Distinctive features of the Malaysian material include: a convex-depressed, striate pileus 16-58 mm diam coloured grayish brown to brownish orange with a pinkish brown margin; subdistant (10-16), pale brownish grey lamellae; a long (45-150 mm), glabrous, grayish brown stipe; variable basidiospores in the range 17-40  $\times$  5-7  $\mu\text{m}$  with mean 28.4  $\times$  5.8  $\mu\text{m}$ ; no pleurocystidia; broadly clavate cheilocystidia and pileipellis cells in the range 11-30  $\times$  6-16  $\mu\text{m}$  lacking setulae; no caulocystidia; and growth on dicotyledonous leaves. The Malaysian material differs from the description of Antonín (2007) in forming more deeply pigmented lamellae (not white), and in growing on leaf debris (not lignicolous); other features are indistinguishable. Until more material is collected in Malaysia and compared with authentic African specimens, the specimens reported here are tentatively identified as *M. camerunensis*.

15. ***Marasmius purpureostriatus*** Hongo, *J. Jap. Bot.* 33: 344. 1958. (Fig. 20, Plate 2B)

Type: Japan, Otsu City, 7 May 1957, Hongo #1609, Herbarium Hongo (Isotype ZT!).

*Pileus* 5-22 mm diam, convex to plano-convex, disc depressed or subumbilicate, sometimes with an umbo; margin sulcate to plicate; surface dry, dull, hygrophorous,



**Plate 2.** *Marasmius* s.s. in section *Globulares*, *Neosessiles*, *Leveilleani* and *Sicci*. A: *Marasmius* aff. *camerunensis* (x 0.5); B: *Marasmius purpureostriatus* (x 2); C: *Marasmius* aff. *leoninus* (x 1.5); D: *Marasmius tenuissimus* (x 0.5); E: *Marasmius araucariae* var. *sicripes* (x 0.5); F: *Marasmius nummularioides* (x1); G: *Marasmius leveilleanus* (x 0.5); H: *Marasmius iras* (x 1); I: *Marasmius luteomarginatus* (x 3).

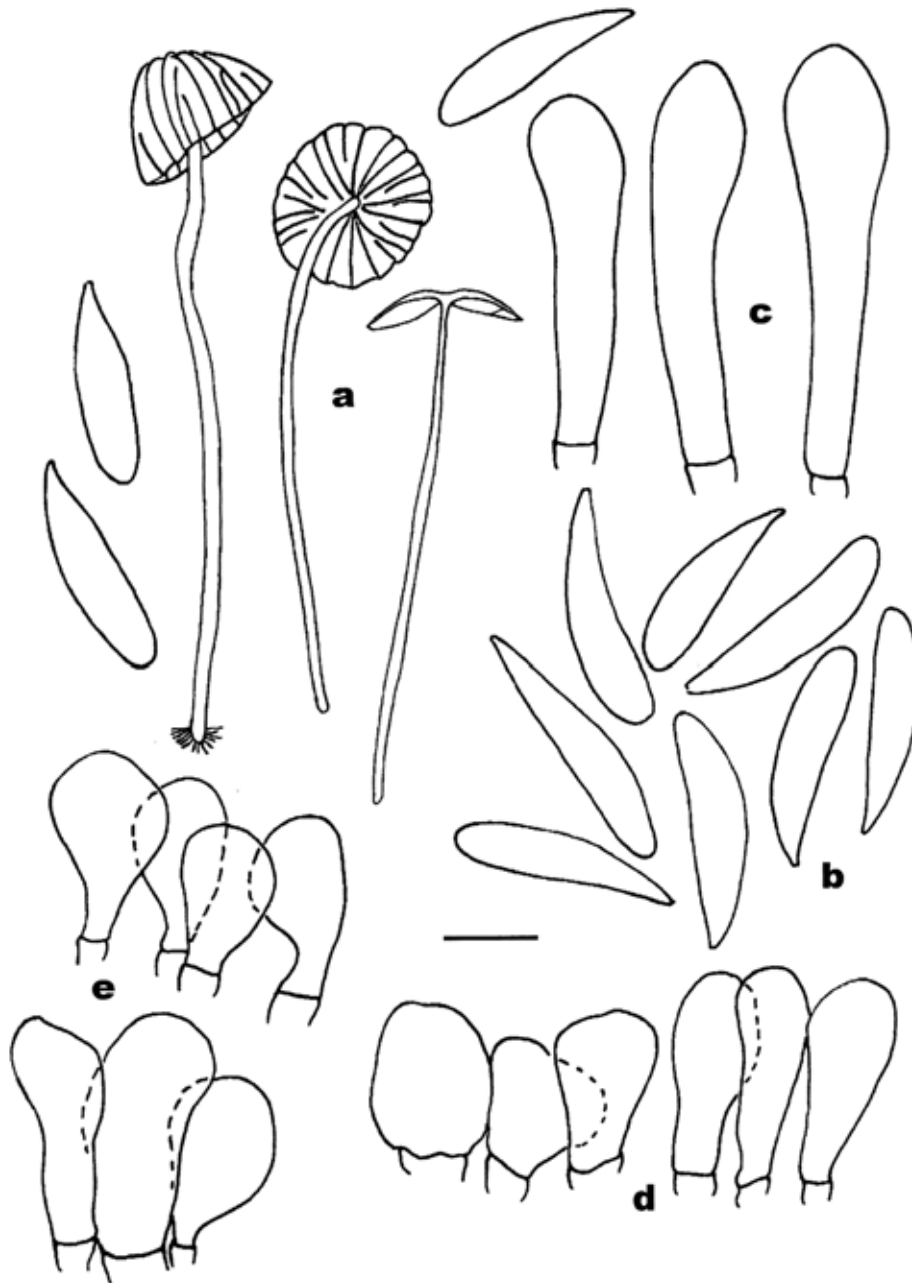
glabrous; disc and radial furrows purplish gray (14E3) to dull violet (17D4) or grayish violet (18E5), dull yellow (3B3) to yellowish white (3A2) elsewhere. *Context* thin (< 1 mm), purplish white. *Lamellae* adnate, distant (10-13) with 1 series of lamellulae, very broad, yellowish white (3A2), non-marginate. *Stipe* 17-50 × 1 mm, central, cylindrical, terete, equal, tough, hollow, dull, dry, non-insititious, yellowish gray (2B2) at apex, grayish yellow (4B4-5) at base, base covered with yellowish white mycelium. *Odor and taste* not distinctive.

*Basidiospores* (20-) 22-26 (-30) × 4-6 μm [ $x = 25 \pm 1.9 \times 5 \pm 0.6 \mu\text{m}$ ,  $Q = 4.2-6.4$ ,  $Q_m = 5.1 \pm 0.5$ ,  $n = 23$  spores], elongated-lacrymoid to narrowly clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* 28-35 × 6 μm, clavate, 4-spored. *Basidioles* 25-30 × 6-7 μm, fusoid to clavate. *Cheilocystidia* common, 16-25 (-27) × 8-12 (-15) μm, subglobose to broadly clavate, hyaline, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* hymeniform, not mottled, composed of clavate to broadly clavate,

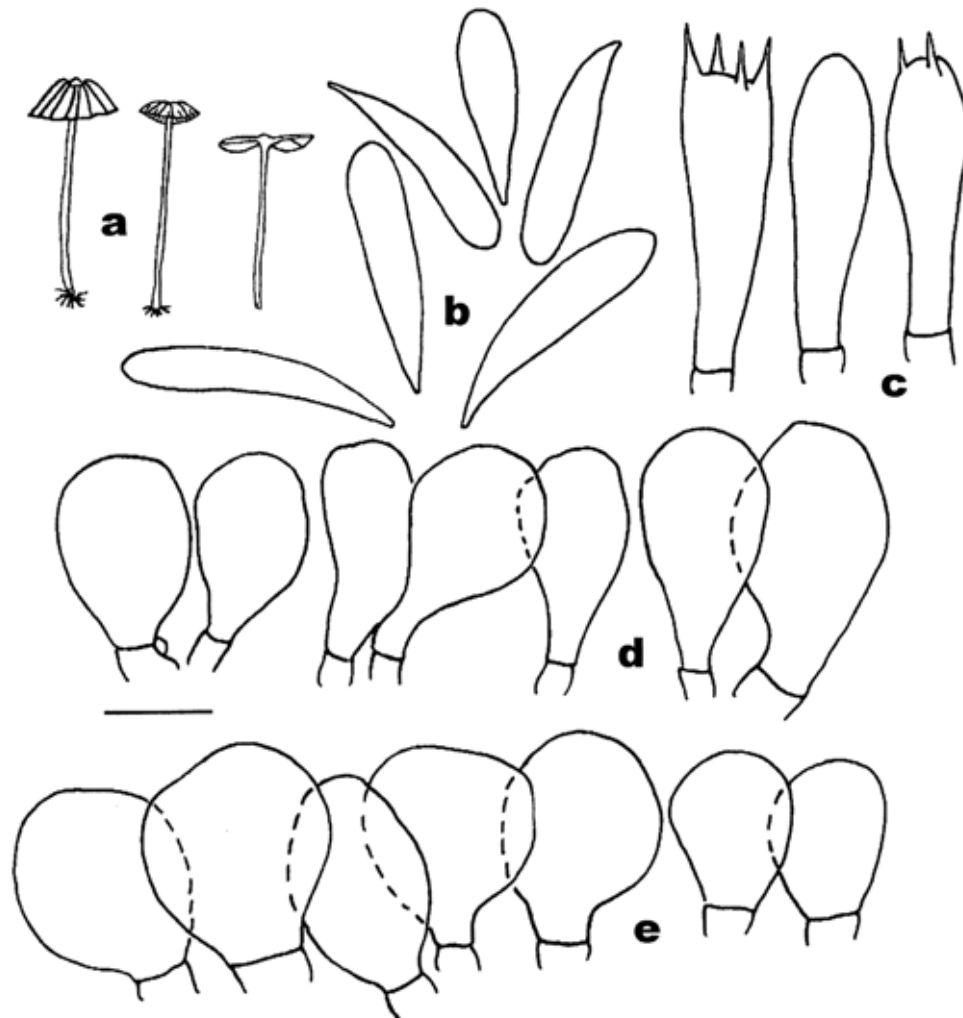


pyriform or subglobose cells 13-24 (-35) × 8-16 (-24) μm, hyaline, inamyloid, thin-walled. *Pileus trama* interwoven; hyphae 4-10 μm diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 4-7 μm diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipe*

*tissue* monomitic; cortical hyphae 6-8 μm diam, parallel, cylindrical, smooth, yellow at apex, pale brown at base, weakly dextrinoid, thick-walled, non-gelatinous; medullary hyphae 4-9 μm diam, parallel, cylindrical, smooth, hyaline, inamyloid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.



**Fig. 19.** *Marasmius* aff. *camerunensis* (KUM 60134 = KLU-M#46). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10 μm.



**Fig. 20.** *Marasmius purpureostriatus* (TYS 328 = KLU-M#92). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 20 mm, b-e = 10 µm.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Japan, Malaysia (Kuala Lumpur), Papua New Guinea, Thailand.

*Material examined.* Malaysia, Kuala Lumpur, University of Malaya, 21 Jul. 2004, S. Vikineswary, TYS 328 (KLU-M#92, SFSU).

*Notes:* *Marasmius purpureostriatus* is characterized by forming a striped, plicate pileus coloured grayish violet to dull violet on the disc and radial furrows and pale yellowish white elsewhere, distant (10-13), very broad lamellae, a glabrous, pallid stipe, long, clavate basidiospores (22-26 × 4-6 µm), an absence of pleurocystidia and caulocystidia, and association with dicotyledonous debris. This species have been reported previously from Papua New Guinea (Desjardin & Horak, 1997).

*Marasmius* sect. *Neosessiles* Singer, Mycologia 50: 104. 1958.

Type species: *Marasmius neosessilis* Singer.

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

(Fig. 21, Plate 2D)

= *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. & Broome) Petch, in Petch & Bisby, Peradeniya Manual. 6: 59. 1950.

Type: Indonesia, Java, near Kebokoening, May (L).

*Pileus* (2.5-) 15-40 (-45) mm diam, irregularly convex in face view, to campanulate in side view, deeply plicate-folded to rugulose-reticulate, pustulate, dull, dry, glabrous overall

or minutely pruinose near attachment point; disc brownish orange (6-7C7-8), grading to pale orange (6B4-5) to orangish white (5A2-3) at the margin, nearly cream-buff on the margin of large basidiomes. *Context* thin, white. *Lamellae* adnexed, remote, interwoven and anastomosing to subreticulate, with many transverse lamellulae of shorter height, broad (1-4 mm), cream (4A3) to pale orangish white (5A2-3), non-marginate. *Stipe* usually absent, rarely lateral and rudimentary, up to 2 × 1 mm, cylindrical, pruinose, white with a brown base, non-insititious. *Odor* none.

*Basidiospores* (6-) 7-10 × 3-6 μm [ $x_{mr} = 7.1-9.4 \times 3.3-5.2 \mu\text{m}$ ,  $x_{mm} = 8.5 \pm 1.2 \times 4.6 \pm 0.8 \mu\text{m}$ ,  $Q = 1.3-2.4$ ,  $Q_{mr} = 1.7-2.1$ ,  $Q_{mm} = 1.9 \pm 0.2$ ,  $n = 20$  spores per 5 specimens], ellipsoid to fusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* 30 × 4 μm, 4-spored. *Basidioles* 29 × 6 μm, fusoid. *Cheilocystidia* common, polymorphic, composed of *Siccus*-type broom cells; main body (10-) 11-16 (-17) × (5-) 6-9 μm, cylindrical to clavate, fusoid or irregular in outline, rarely lobed, hyaline, inamyloid, thin- to thick-walled; apical setulae 1-3 × 1 μm, broadly conical to irregularly cylindrical or knobby, obtuse to subacute, rarely forked, hyaline, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of two types of cells: a) *Siccus*-type broom cells with main body (6-) 10-20 (-25) × (5-) 7-11 μm, clavate to broadly clavate, cylindrical or irregular in outline, rarely lobed, hyaline to yellowish brown, inamyloid, thick-walled; apical setulae (1-) 3-5 (-7) × 1-2 μm, broadly conical, obtuse to subacute, yellow to yellowish brown, inamyloid to dextrinoid, thin- to thick-walled (up to 2 μm); b) *Globulares*-type cells, rare, 9-13 × 10-18 μm, clavate to subglobose or irregular in outline, rarely lobed, non-setulose, hyaline, inamyloid to dextrinoid, thick-walled (0.5-1.5 μm). *Pileus trama* interwoven; hyphae 5-7 μm diam, cylindrical, hyaline, dextrinoid, thin-walled, slightly gelatinous. *Lamellar trama* regular; hyphae 2-3 μm diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* not observed. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* scattered on undetermined liana stem in

primary montane cloud forest, and gregarious on bamboo leaves and on undetermined dicotyledonous leaves and twigs. Indonesia (Java), Malaysia (Kedah, Pahang, Selangor), Thailand.

*Material examined:* Malaysia, Kedah, Langkawi Island, Matchinchang, 1 Sept. 2004, Yee-Shin Tan, TYS 345 (KLU-M#100, SFSU); Pahang Prov., Fraser's Hill, Hemmant Trail, N03°42.925', E101°44.306', elev. 1200 m., 15 Jan. 2004, E. Horak, DED 7659 (KLU-M#102, SFSU); Selangor, Hulu Langat, Sungai Chongkak Forest Reserve, 16 May 2005, Yee-Shin Tan, TYS 468 (KLU-M#101, SFSU); Selangor, Ulu Gombak, University of Malaysia's Field Study Centre, 28 Nov. 2004, Yee-Shin Tan, TYS 398 (KLU-M#103, SFSU); same location, 5 Jan. 2005, Yee-Shin Tan, TYS 392 (KLU-M#104).

*Notes:* *Marasmius tenuissimus* is characterized by moderately large, deeply plicate-folded to rugulose-reticulate, pale orange pileus, adnexed, broad, intervenose lamellae, sessile basidiomes or with a rudimentary lateral to eccentric stipe, relatively short and broad basidiospores, and growth on liana stems and dicotyledonous leaves. It is the only commonly encountered *Marasmius* in Southeast Asia that lacks a stipe and has *Siccus*-type broom cells. Molecular data suggest that it is more closely related to species currently placed in sect. *Marasmius* subsect. *Sicciformes* and sect. *Leveilleani*, than it is to members of sect. *Sicci*.

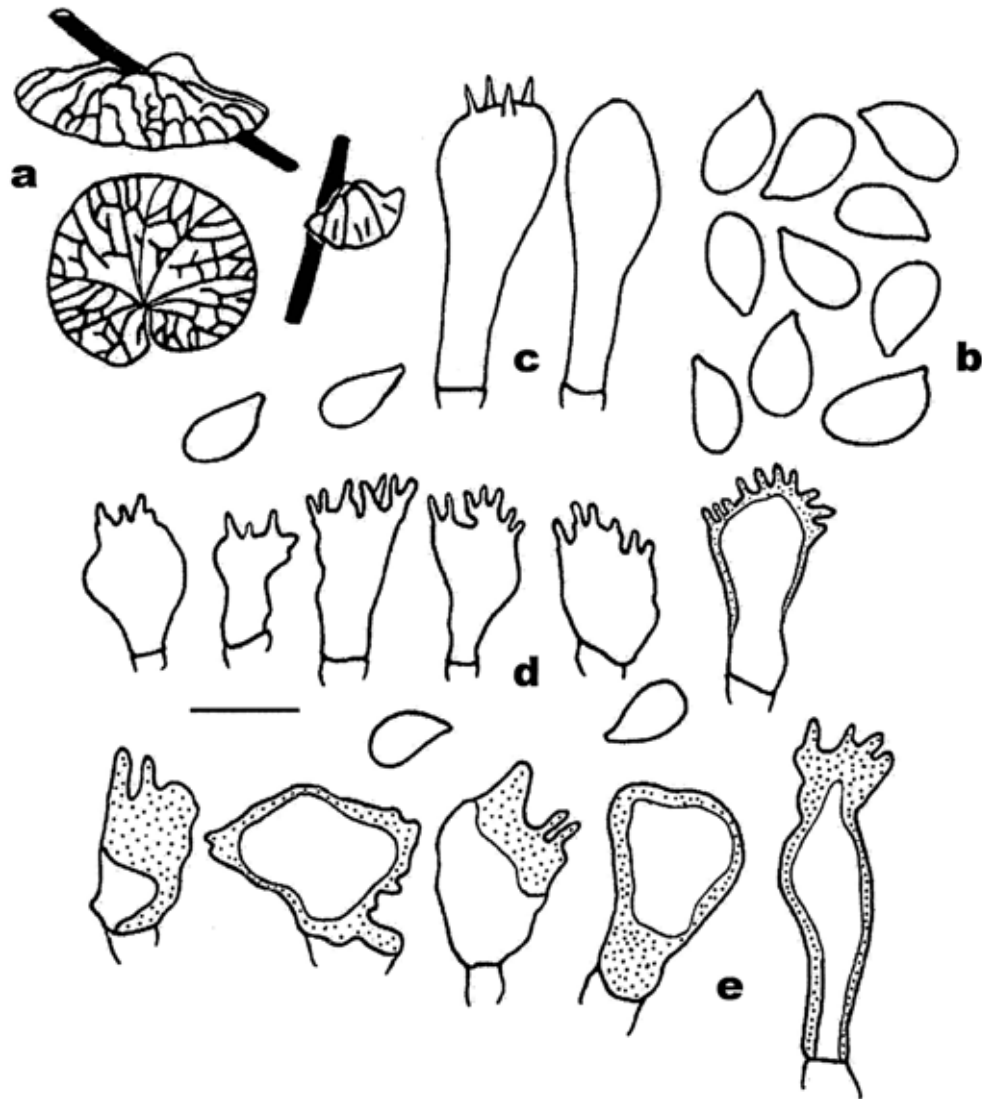
***Marasmius* sect. *Hygrometrici* Kühner**, *Botaniste* 25:95. 1933.

Type species: *Marasmius hygrometricus* (V. Brig.) Sacc. [= *Marasmius corbariensis* (Roum.) Sacc. & Traverso].

17. ***Marasmius micraster* Petch**, *Trans. Brit. Mycol. Soc.* 31: 42. 1947. (Fig. 22)

Type: Sri Lanka, Kandy District, Peradeniya, 21 Oct. 1914, Petch 4195 (K).

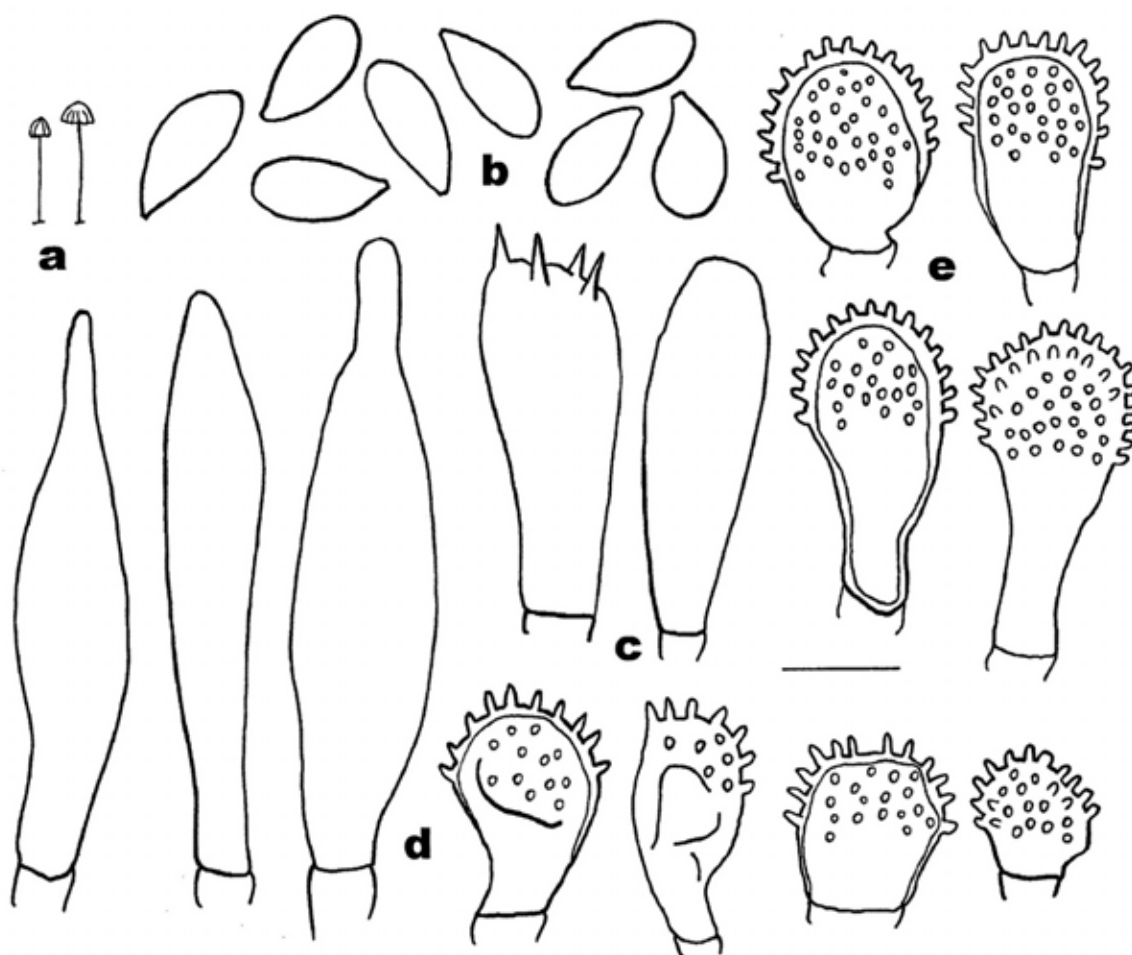
*Pileus* 1-2 mm diam, convex to obtusely conical, smooth when young, becoming striate to sulcate in age, dull, dry, minutely pruinose, pale grayish brown overall, in age and when expanded becoming paler and with a nearly white margin. *Lamellae* shallowly adnexed, not collariate, distant with 0-1 series of lamellulae, moderately broad (up to 0.5 mm), white. *Stipe* 10-18 × 0.1 mm, central, wiry, glabrous, shiny, tough, insititious, dark brown to black; associated with short, black *rhizomorphs*.



**Fig. 21.** *Marasmius tenuissimus* (DED 7659 = KLU-M#102). a. Basidiomes. b. Basidiospores. c. Basidia and basidiole. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

*Basidiospores* 9-12 (-13)  $\times$  4.5-6.5 (-7)  $\mu$ m [ $x_{mr}$  = 9.9-11.3  $\times$  4.7-6  $\mu$ m,  $x_{mm}$  10.5  $\pm$  0.7  $\times$  5.2  $\pm$  0.6  $\mu$ m, Q = 1.6-2.8,  $Q_{mr}$  = 1.8-2.2,  $Q_{mm}$  = 2  $\pm$  0.2, n= 17 spores per 5 specimens], ellipsoid, smooth, hyaline, inamyloid. *Basidia* 28-35  $\times$  7-10  $\mu$ m, clavate, 4-spored. *Basidioles* 32-40  $\times$  8-10  $\mu$ m, fusoid to clavate. *Pleurocystidia* absent. *Cheilocystidia* composed of two types of cells: a) *Rotalis*-type broom cells with main body 33-42 (-60)  $\times$  7-12 (-16)  $\mu$ m, subclavate to clavate or subglobose, hyaline, inamyloid, thin-walled or apically thick-walled; divergent setulae 1-2  $\times$  0.5-1  $\mu$ m, cylindrical, densely setulose over the upper half of cell, hyaline, inamyloid, thin-walled; b) non-setulose cells, 30-36  $\times$  7-9 (-12)  $\mu$ m, clavate to cylindrical or more commonly fusoid, hyaline, inamyloid, thin-walled. *Pileipellis*

mottled, composed of a hymeniform layer of *Rotalis*-type broom cells; main body 17-22 (-30)  $\times$  8-20 (-22)  $\mu$ m, broadly clavate to subglobose, hyaline to pale orangish brown, inamyloid, thin-walled; divergent setulae 1-1.5  $\times$  0.5-1  $\mu$ m, cylindrical, obtuse, light yellow, inamyloid, thin-walled. *Pileus trama* interwoven; hyphae 3-5  $\mu$ m diam, cylindrical, hyaline, inamyloid, thin-walled. *Lamellar trama* regular; hyphae 3-8  $\mu$ m diam, cylindrical, hyaline, inamyloid, thin-walled. *Stipe tissue* monomitic; cortical hyphae 5-8  $\mu$ m diam, parallel, cylindrical, densely setulose overall, thin- to thick-walled, brown, inamyloid; setulae thin-walled, hyaline, inamyloid; medullary hyphae 4-6  $\mu$ m diam, parallel, smooth, thin-walled, pale yellow, inamyloid. *Caulocystidia* absent. *Clamp connections* present.



**Fig. 22.** *Marasmius micraster* (TYS 229 = KLU-M#86). a. Basidiomes. b. Basidiospores. c. Basidia and basidiole. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

*Habit, habitat and known distribution:* gregarious on petioles and main veins of undetermined dicot trees; in Malaysia on a single species of tree with very large leaves, ca 30-40 cm long  $\times$  15-20 cm wide in lowland forests. Indonesia (Java), Malaysia (Selangor, Pahang), New Zealand, Singapore, Sri Lanka.

*Material examined:* Malaysia, Pahang, Cameron Highlands, Brinchang mountain, jungle walk no.1, N 04°31.087', E 101°22.971', elev. ca 2210 m, 10 Jan. 2004, Yee-Shin Tan, TYS 229 (KLU-M#86, SFSU); Selangor, Ulu Gombak, University of Malaya's Field Study Centre, N 03°19.500', E 101°45.167', elev. ca 240 m, 13 Jan. 2004, D.E. Desjardin, DED 7647= TYS 237 (KLU-M#82, SFSU); same location, 27 Aug. 2003, Yee-Shin Tan, TYS 068 (KLU-M#83, SFSU); same location, 5 Jan. 2005, Yee-Shin Tan, TYS 391 (KLU-M#84, SFSU); same location, 5 Jan. 2005, Yee-Shin Tan, TYS 393 (KLU-M#85, SFSU).

*Notes:* *Marasmius micraster* was described originally from Sri Lanka and has been reported recently from New Zealand (Desjardin & Horak, 1997) and Indonesia (Desjardin *et al.*, 2000). Distinctive features of

this tiny taxon include a small, pale grayish brown, sulcate pileus, distant and non-collariate lamellae, a wiry, glabrous stipe associated with black rhizomorphs, basidiospores in the range of 9-12  $\times$  4.5-6.5  $\mu$ m, *Rotalis*-type cheilocystidia and pileipellis broom cells, and growth on dicotyledonous leaves. The Malaysian material differs from Indonesian specimens in having slightly larger basidiospores with mean 10.5  $\times$  5.2  $\mu$ m versus 9  $\times$  4.5  $\mu$ m in Indonesia (Desjardin *et al.*, 2000).

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

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

18. ***Marasmius leveilleanus*** (Berk.) Pat., Bull. Soc. Mycol. Fr. 33: 55. 1917.

(Fig. 23, Plate 2G)

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

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

Type: Sri Lanka, Hautane Range, July 1844, Gardner 72 (K #99705).

*Pileus* 10-36 mm diam, convex to broadly convex, distinctly depressed or with an umbo; margin striate to sulcate; surface dry, dull, subvelutinous; reddish brown (8D7) to brown (7D7), light brown (7D6) or brownish orange (7C8). *Context* thin, yellowish white. *Lamellae* free, no collarium, subdistant to close (20-24), pale yellow (3A3), non-margined. *Stipe* 16-80 × 1 mm, central, cylindrical, terete, dry, dull, glabrous, shiny, insititious, light brown at apex, dark brown at base; associated with coarse dark brown *rhizomorphs*.

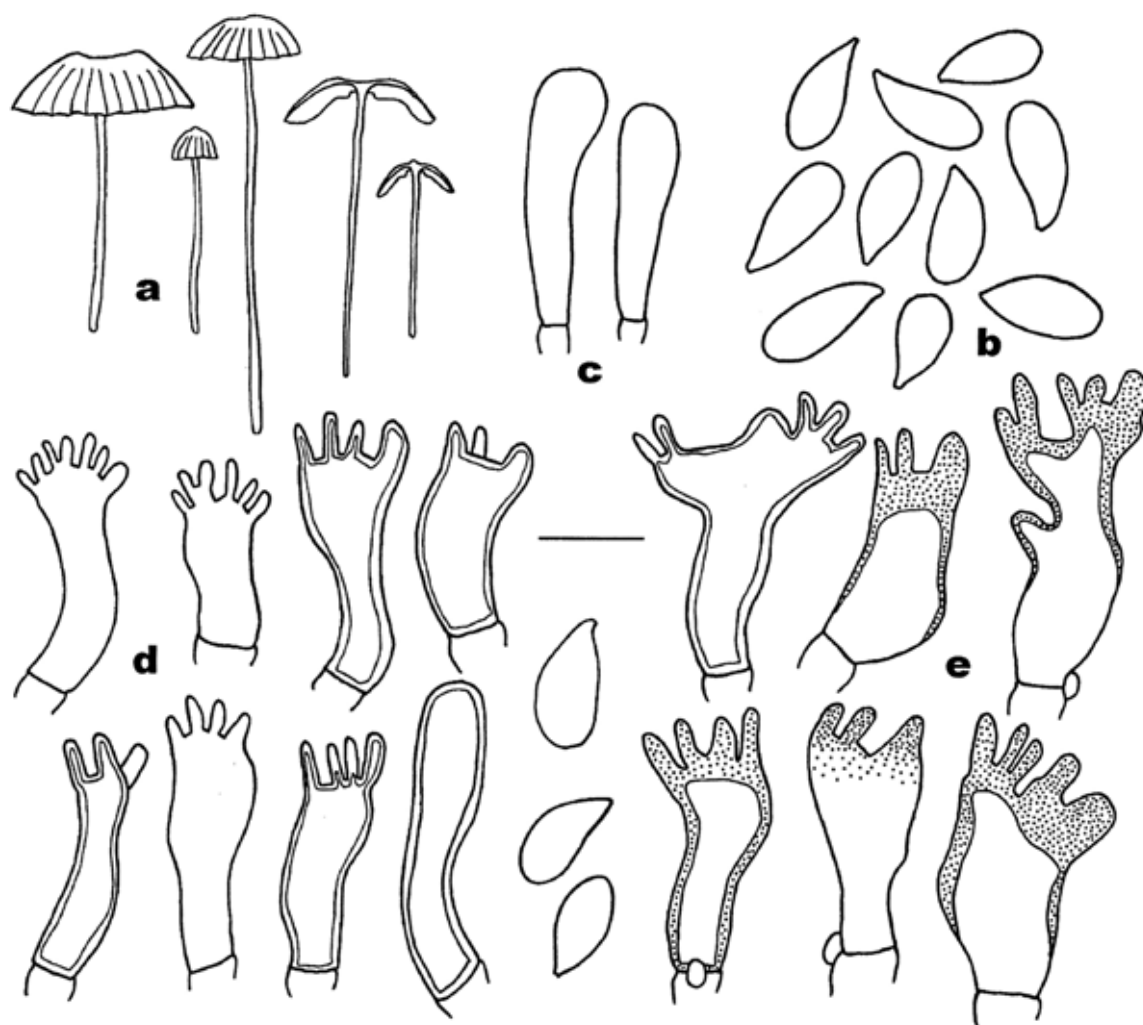
*Basidiospores* (8-) 9-12 (-12.5) × 4-5.5 μm [ $x_{mr} = 9.6-11.6 \times 4.9-5.1 \mu\text{m}$ ,  $x_{mm} = 10.6 \pm 1 \times 5 \pm 0.1 \mu\text{m}$ ,  $Q = 1.7-2.9$ ,  $Q_{mr} = 1.8-2.4$ ,  $Q_{mm} = 2.2 \pm 0.2$ ,  $n = 21$  spores per 3 specimens], ellipsoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* 18-23 × 5-6 μm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (10-) 16-30 (-38) × (5-) 6-10 μm, cylindrical to clavate, rarely lobed, light yellow, inamyloid, thin- to thick-walled; apical setulae 3-6 (-8) × 1.5-2 (-3) μm, bluntly or broadly conical to knobby, rarely forked, hyaline, inamyloid, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of two types of cells: a) *Siccus*-type broom cells with main body (9-) 17-30 (-40) × (6-) 8-10 (-11) μm, cylindrical to clavate, broadly clavate or irregular in outline, rarely lobed, hyaline to light yellowish brown, inamyloid, thick-walled; apical setulae 5-8 × 1-3 (-4) μm, cylindrical to broadly conical or knobby, obtuse, yellowish brown to tawny, inamyloid, thin- to thick-walled; b) rare, scattered non-setulose cells, clavate, tawny, apically thick-walled. *Pileus trama* interwoven; hyphae 3.5-6 μm diam, cylindrical, hyaline, inamyloid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 3-7 μm diam, cylindrical, hyaline to light yellow, inamyloid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 5-7 μm diam, parallel, cylindrical, smooth, light yellow at stipe apex, pale brown at base, inamyloid or weakly dextrinoid, thick-

walled; medullary hyphae 5-10 μm diam, parallel, cylindrical, smooth, hyaline, inamyloid or weakly dextrinoid, thin-walled. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves and dead wood. Africa (DR Congo, Ghana, Ivory Coast, Nigeria, Uganda), Malaysia (Kedah, Selangor), Mexico, Sri Lanka, Thailand.

*Material examined:* Malaysia, Kedah, Langkawi Island, Lubuk Semilang Forest Reserve, N 6° 21' 51.9, E 99° 47' 25.8, 49 m alt., 8 Apr. 2004, Yee-Shin Tan, KUM 60142 (SFSU); Langkawi Island, Mat ChinChang, Datai, 7 Apr. 2004, Yee-Shin Tan, KUM 116a (SFSU); Selangor, Ulu Gombak, University of Malaya's Field Study Centre, 28 Nov. 2004, Yee-Shin Tan, TYS 386 (KLU-M#80).

*Notes:* The monotypic section *Leveilleani* was erected around *M. leveilleanus* and circumscribed to contain species with the following unique combination of features: rather large (10-36 mm diam), deeply pigmented pilei composed of a hymeniform layer of a few smooth, thick-walled cells plus numerous *Siccus*-type broom cells with few, broad, knobby, obtuse setulae; free, non-collariate lamellae; a thick and wiry, insititious stipe associated with rhizomorphs; non-dextrinoid hyphae; and an absence of pleurocystidia. Indeed, the single known species shows features of both sect. *Marasmius* (insititious stipe and rhizomorphs) and sect. *Sicci* (large basidiomes with non-collariate lamellae and *Siccus*-type broom cells). The molecular data suggest that *M. leveilleanus* is more closely allied with members of sect. *Marasmius* than with sect. *Sicci*. This is the only known member of the genus *Marasmius* with truly free lamellae. In *M. leveilleanus* there is a smooth ring of pileus tramal tissue surrounding the area where the stipe attaches to the pileus such that the lamellae stop short of the stipe by about 1 mm. The Malaysian specimens are lignicolous and are associated with coarse, thick, wiry, glabrous rhizomorphs (similar in morphology to the stipes) but the basidiomes do not arise directly from them. Rhizomorphs were not reported from Sri Lankan material, but they were reported from material collected in Africa (Antonín, 2007). It will be interesting to see if the New World



**Fig. 23.** *Marasmius leveilleanus* (KUM 60142 = KLU-M#79). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

specimen reported by Singer (1976) from Mexico represents the same taxon as this widespread paleotropical *M. leveilleanus*.

***Marasmius* sect. *Sicci* Singer, subsect. *Siccini* Singer, ser. *Spinulosi* (Cléménçon) Desjardin, in Antonín & Noordeloos, Lib. Bot. 8: 179. 1993.**

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

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

19. ***Marasmius nummularioides* Desjardin & Y.S. Tan, Fungal Diversity 25: 200. 2007.**

(Fig. 24, Plate 2F)

Type: Malaysia, Johore, Endau Rompin National Park, Peta Village, 14 July 2005, Y.S. Tan #508 (KLU-M #7!).

*Pileus* 5-16 mm diam, convex, with or without an umbo, disc rugulose, margin smooth (non-striate); surface dry, dull, minutely velutinous; reddish brown (8D-E6-8) to brown (7E6-8) overall when young, margin fading to brown (6D-E6-7) in age. *Lamellae* adnate, crowded (16-18) with 3-4 series of lamellulae, narrow, yellowish white with brown marginate edges. *Stipe* 16-40  $\times$  1 mm, central, cylindrical, terete, equal, dry, dull, pruinose to hispidulous, non-insititious with brownish orange basal tomentum, yellowish orange to brownish orange overall when young, or with a yellowish white apex, gradually changing to brownish orange, light brown or brown in age.

*Basidiospores* (15-) 16-18 (-19)  $\times$  (3.5-) 4-4.5  $\mu$ m [ $x = 16.7 \pm 1.1 \times 4.1 \pm 0.3 \mu$ m,  $Q = 3.5-4.8$ ,  $Q_m = 4.0 \pm 0.3$ ,  $n = 22$  spores], elongate-lacrymoid to fusoid or clavate, smooth, hyaline, inamyloid. *Basidia* not

observed. *Basidioles* 26-30 × 6-8 μm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body 14-20 (-28) × 6-10 μm, cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin- to thick-walled; apical setulae 4-8 × 0.5-1 μm, crowded, cylindrical to conical, subacute to obtuse, rarely forked, light brownish yellow, weakly dextrinoid, thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 10-30 × 6-10 (-13) μm, cylindrical to clavate, broadly clavate or irregular in outline, rarely lobed, hyaline to pale yellowish brown, weakly dextrinoid, thick-walled; apical setulae 5-13 (-17) × 1-2 μm, cylindrical to conical, rarely forked, light brownish yellow to brown, weakly dextrinoid, thick-walled. *Pileus trama* subparallel to interwoven; hyphae 4-6 μm diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 5-8 μm diam, cylindrical, hyaline to light yellow, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 3.5-5 μm diam, parallel, cylindrical, smooth, light brown (apex) to yellowish brown (base), weakly dextrinoid, thick-walled (-1 μm); medullary hyphae 4-8 μm diam, parallel, cylindrical, smooth, hyaline, dextrinoid, thin-walled. *Caulocystidia* numerous, composed of *Siccus*-type broom cells, setae-like cells and cauloseetae; main body of broom cells and setae-like cells 14-25 × 8-15 μm, cylindrical to broadly clavate, light yellow to light brown, inamyloid, thick-walled; apical setulae 6-60 × 2-4 μm, conical to acicular, light yellow, inamyloid, thick-walled. *Cauloseetae* scattered, 50-100 × 3-5 μm, lanceolate, light brown, inamyloid, thick-walled. *Clamp connections* present.

*Habit, habitat and known distribution:* solitary and gregarious on undetermined dicotyledonous leaves. Malaysia (Johore).

*Material examined:* Malaysia, Johore, Endau Rompin National Park, on the way to NERC, Peta Village, Temiang trail, 14 July 2005, Yee-Shin Tan, TYS 508 (**Holotype:** KLU-M #7; **Isotype:** SFSU).

*Notes:* *Marasmius nummularioides* is characterized by relatively small, non-striate, rugulose pileus coloured brown to reddish

brown, by crowded, narrow lamellae with brown margins, and by a pruinose to hispidulous stipe with brownish orange basal mycelium. In addition, the species forms basidiospores with mean 16.7 × 4.1 μm, has *Siccus*-type cheilocystidia and pileipellis broom cells, and lacks pleurocystidia, hymenial setae and pileosetae. The most distinctive microscopic feature is the caulocystidia that are a combination of *Siccus*-type broom cells with very long setulae and narrow setae. The new species is allied with *M. nummularius* Berk. & Broome from Sri Lanka and Indonesia, and with *M. spiculosus* Singer and *M. atrorubens* (Berk.) Berk., both from South America and the Caribbean (*M. atrorubens* is also known from tropical Africa). *Marasmius nummularius* differs from *M. nummularioides* in forming smaller basidiospores (mean 13.6 × 4.0 μm) and in having a stipitipellis covered with very long, usually simple cauloseetae, lacking *Siccus*-type caulocystidia (Desjardin *et al.*, 2000). *Marasmius spiculosus* differs in forming a distinctly sulcate pileus with numerous pileosetae, and has refractive pleurocystidia. Interestingly, the stipitipellis is almost identical to that of *M. nummularioides* (Singer, 1976; Pegler, 1983). *Marasmius atrorubens* differs in forming a distinctly sulcate pileus with scattered pileosetae, may or may not have pleurocystidia, and forms a stipitipellis covered with simple cauloseetae, lacking *Siccus*-type broom cells (Singer, 1976; Pegler, 1983; K!).

A bipolar (unifactorial) mating system was reported for *M. nummularioides* by Tan *et al.* (2007).

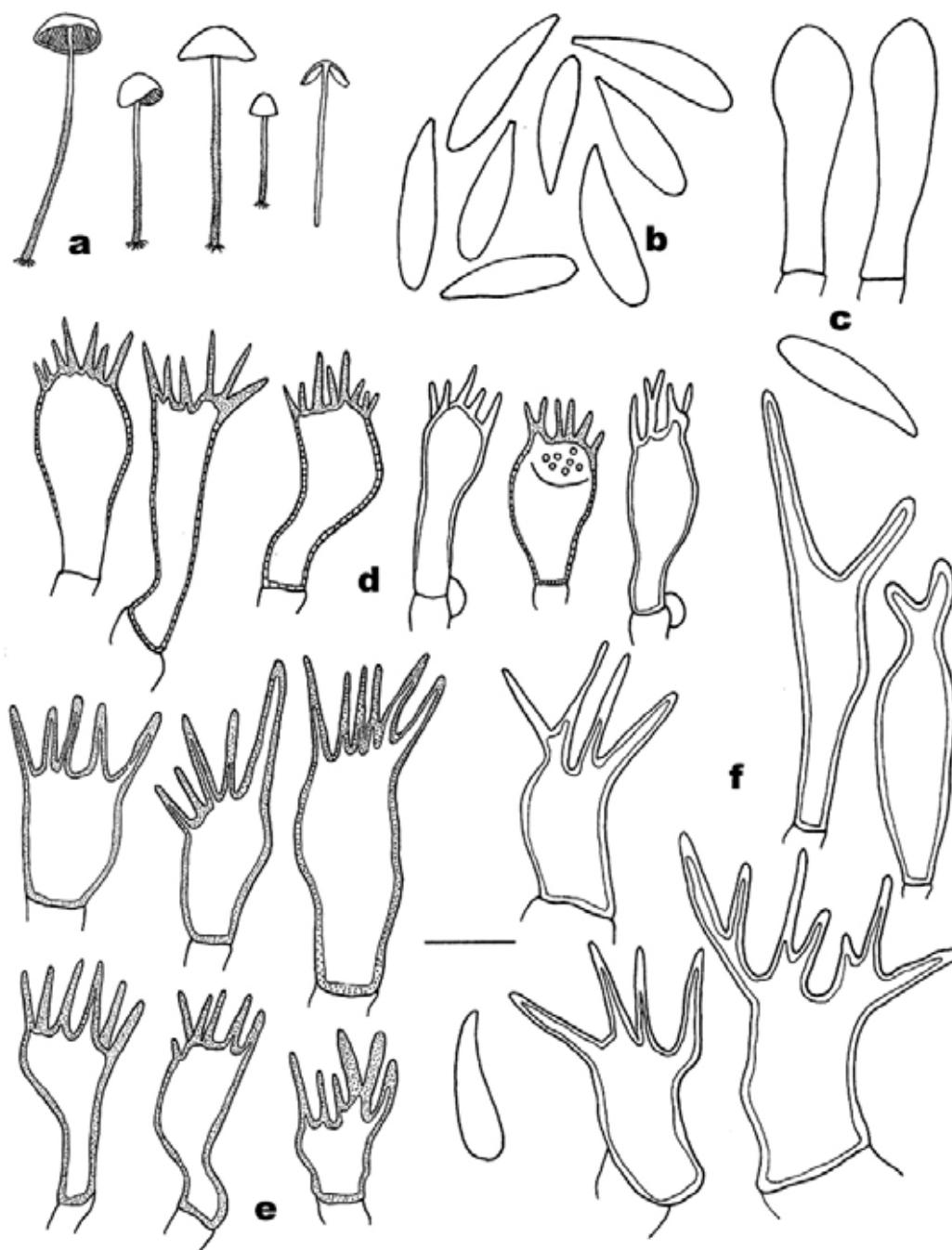
***Marasmius* sect. *Sicci* Singer, subsect. *Siccini* Singer, ser. *Atrorubentes* Desjardin & Horak, Biblio. Mycol. 168: 27. 1997.**

Typespecies: *Agaricus atrorubens* Berk., London J. Bot. 1: 138. 1842 [≡ *Marasmius atrorubens* (Berk.) Berk., Hooker's J. Bot. Kew. Gard. Misc. 8: 137. 1856].

20. ***Marasmius musicolor* Y.S. Tan & Desjardin, sp. nov.** (Fig. 25)  
Mycobank: MB512625

*Etymology:* musi- (Latin) = banana; -color (Latin) = coloured, referring to the banana coloured pileus.



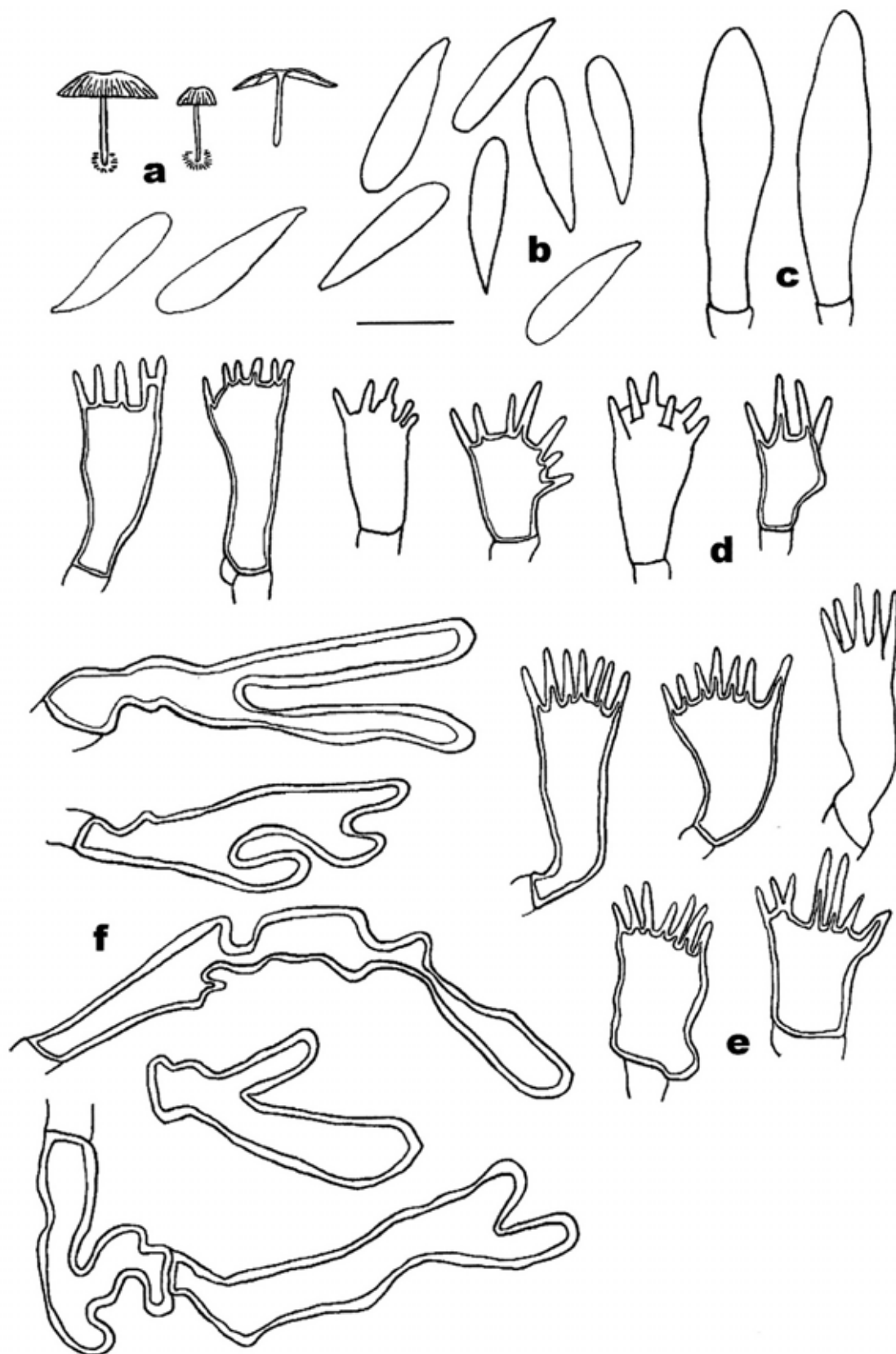


**Fig. 24.** *Marasmius nummularioides* (Holotype: TYS 508 = KLU-M#7). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. f. Caulocystidia. Bars: a = 10 mm, b-f = 10 µm.

*Pileus* 7-21 mm latus, convexus vel plano-convexus, ad apicem rugulosus, ruguloso-striatus, subvelutinus, pallide luteus vel musicolor. Lamellae adnatae, densae (12-14), angustae, cremeae, haud marginatae. Stipes 11-15 × 0.5-1 mm, cylindricus, pruinosis, haud insititius, apicaliter luteus, basim versus brunneo-aurantiacus, ad basim tomento pallide aurantio-aldido affixus. Basidiosporae 15-18 × 3.5-4 µm, clavatae, leves, hyalinae, inamyloideae. Basidiola 32-40 × 7 µm, fusiodeae vel clavatae. Cheilocystidia typi Sicci, 10-22 × 7-8 µm, cylindracea vel clavata, hyalina; setulae ad apicem 2-6 × 0.5-1 µm, densae, cylindrcae vel conicae, subacutae vel obtusae, pallide flavae, inamyloideae, tenui- vel crasse-tunicatae. Pleurocystidia nulla. Pileipellis hymeniformis, typi Sicci, cellulae 14-19 × 6-

10 µm, cylindrcae vel clavatae, hyalinae, inamyloideae, crasse-tunicatae; setulae ad apicem 4-8 × 0.5-1 µm, cylindrcae vel conicae, hyalinae vel pallide flavae, pallide dextrinoideae, tenui- vel crasse-tunicatae. Caulocystidia versiformae, proximus basi, cellulae 55-90 × 4-7 µm, cylindrcae vel clavatae, apicaliter ramosa, pallide flavae, dextrinoideae, tenui-tunicatae apice, basi crasse-tunicatae. Fibulae presentes. Gregarius, ad folia putrida plantarum dicotyledonearum. Holotypus: Malaysia, Selangor, Selayang, Kanching Forest Reserve, N 03° 17.958', E 101°37.151'. 8 Jan 2005, collected by Amy Honan, TYS 417 (Holotypus: KLU-M#87).

*Pileus* 7-21 mm diam, convex to plano-convex, without an umbo, disc rugulose,



**Fig. 25.** *Marasmius musicolor* (Holotype: TYS 417 = KLU-M#87). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. f. Caulocystidia. Bars: a = 10 mm, b-f = 10  $\mu$ m.

margin rugulose-striate; surface dry, dull, hygrophanous, subvelutinous; light yellow (3A5, 4A4-5) to banana-coloured overall.

*Lamellae* adnate, close (12-14) with 4 series of lamellulae, narrow, sometimes forked, pale yellow, non-marginate. *Stipe* 11-15  $\times$  0.5-1 mm,

central, cylindrical, terete, equal, dry, dull, pruinose, non-insititious, pale yellow (3A3) at apex, brownish orange (5C5. 6C6-7) at base, with orangish white mycelium.

*Basidiospores* (13-) 15-18 (-19) × 3.5- 4 μm [ $x = 16.1 \pm 1.7 \times 3.9 \pm 0.2$  μm,  $Q = 3.7-5.1$ ,  $Q_m = 4.9 \pm 0.5$ ,  $n = 10$  spores], elongate-lacrymoid to clavate, smooth, hyaline, inamyloid. *Basidia* not observed. *Basidioles* 32-40 × 7 μm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (6-) 10-22 (-26) × (5-) 7-8 (-11) μm, cylindrical to clavate or subclavate, hyaline, inamyloid, thin- to thick-walled; apical setulae 2-6 (-7.5) × 0.5-1 μm, close, cylindrical to conical, subacute to obtuse, rarely forked, light yellow, inamyloid, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* weakly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (10-) 14-19 (-20) × (5-) 6-10 (-11) μm, cylindrical to clavate or broadly clavate, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae (2-) 4-8 × 0.5-1 μm, cylindrical to conical, rarely forked, hyaline to light yellow, inamyloid to weakly dextrinoid, thin- to thick-walled. *Pileus trama* interwoven; hyphae 3-4 μm diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 3-6 μm diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 3-6 μm diam, parallel, cylindrical, smooth, brownish yellow, dextrinoid, thick-walled; medullary hyphae 4-12 μm diam, parallel, cylindrical, smooth, hyaline, strongly dextrinoid, thick-walled (up to 1 μm), non-gelatinous. *Caulocystidia* numerous near the base of stipe, 55-90 × 4-7 μm, cylindrical to clavate, branched and often apically lobed, light yellow, strongly dextrinoid, thin-walled apically, thick-walled at the base. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous twigs. Malaysia (Selangor).

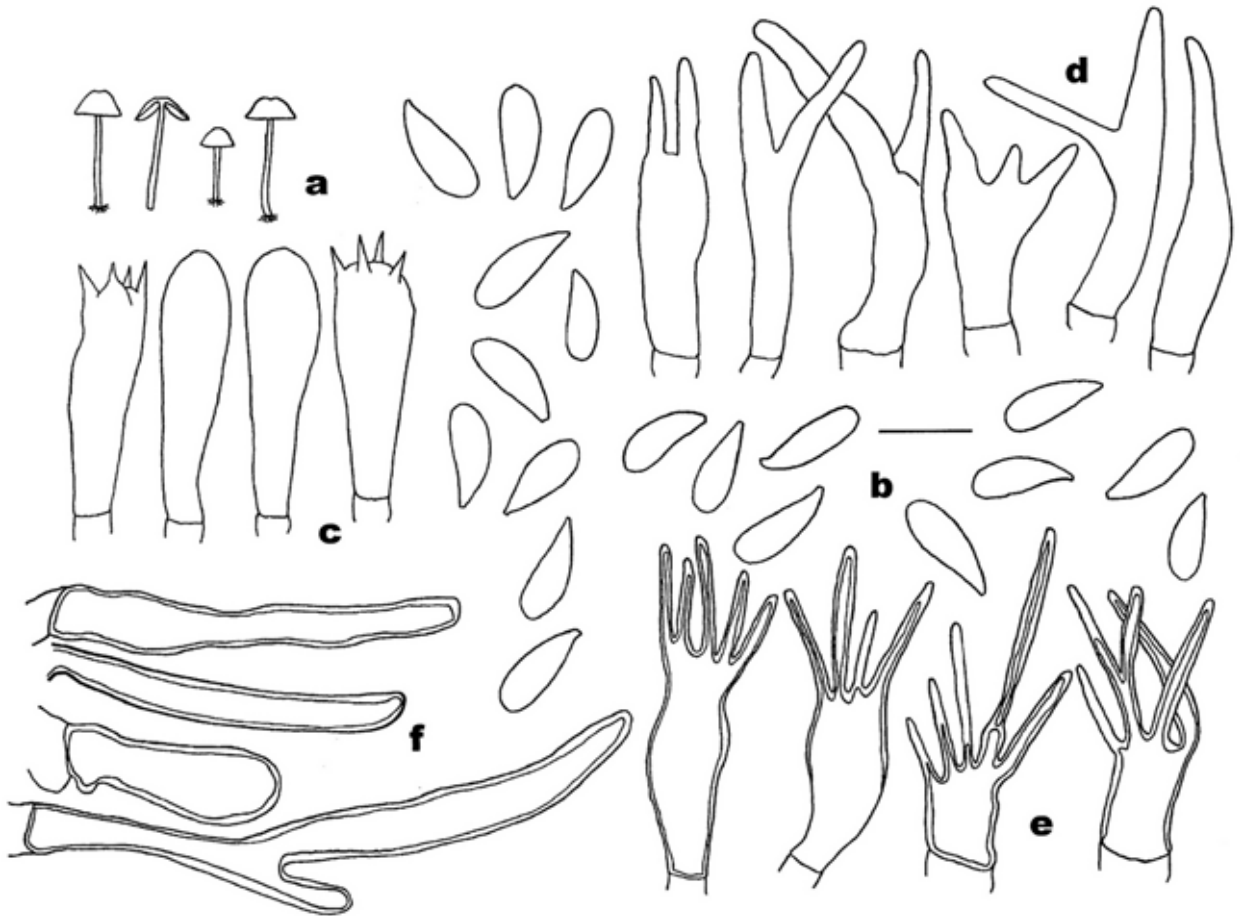
*Material examined:* Malaysia, Selangor, Selayang, Kanching Forest Reserve, N 03° 17.958', E 101° 37.151'. 8 Jan 2005, Amy Honan, TYS 417 (**Holotype:** KLU-M#87; **Isotype:** SFSU).

*Notes:* *Marasmius musicolor* is characterized by the following features: a convex to plano-convex, rugulose-striate pileus 7-21 mm diam that is coloured banana yellow overall; non-marginate, close (12-14) lamellae with 4 series of lamellulae; a pruinose stipe 11-15 mm long with pale yellow apex and brownish orange base; basidiospores 13-19 × 3.5-4 μm with mean 16.1 × 3.9 μm; no pleurocystidia; *Siccus*-type cheilocystidia with setulae 2-6 μm long; *Siccus*-type pileipellis broom cells with setulae 4-8 μm long; numerous obtuse, cylindrical caulocystidia that are often forked or lobed, and an absence of *Siccus*-type caulocystidia; and growth on twigs. In combination, these features are not similar to any published species, but resemble those present in *M. iras* described herein as new. *Marasmius iras* differs, however, in forming a brown pileus, smaller basidiospores (13-16 × 3-4 μm with mean 14.1 × 3.7 μm), has less branched or lobate caulocystidia, and grows on leaves.

21. *Marasmius ochropoides* Y.S. Tan & Desjardin, **sp. nov.** (Fig. 26)  
Mycobank: MB 512627

*Etymology:* ochropoides = like *M. ochropus* Singer.

Pileus 5-6 mm latus, convexus, leves vel striatulus, subvelutinus, pallide aurantio vel aurantio-brunneus. Lamellae adnatae, densae (12-18), angustae, cremeae, haud marginatae. Stipes 11-21 × 0.5-1 mm, cylindricus, pruinosis, haud insititius, apicaliter cremeus, basim versus pallide aurantiacus, ad basim tomento cremeo affixus. Basidiosporae 9-12 × 3-4 μm, clavatae vel ellipsoideae, leves, hyalinae, inamyloideae. Basidia 25-28 × 6-7 μm, clavatae, 4-spora. Cheilocystidia typi Sicci, 15-25 × 5-6 μm, cylindracea vel clavata, hyalina; 2-4 setulae ad apicem, 10-18 × 2-3 μm, cylindricae vel conicae, obtusae, hyalinae, inamyloideae, tenui-tunicatae. Pleurocystidia nulla. Pileipellis hymeniformis, typi Sicci, cellulae 10-16 × 6-10 μm, cylindricae vel clavatae, hyalinae, inamyloideae, crasse-tunicatae; setulae ad apicem 9-18 × 0.5-1 μm, cylindricae vel conicae, fulvae vel brunneae, inamyloideae, crasse-tunicatae. Caulocystidia 23-100 × 4-7 μm, cylindricae vel clavatae, obtusae, hyalinae, dextrinoideae, crasse-tunicatae. Fibulae presentes. Gregarius, ad folia putrida plantarum dicotyledonearum. Holotypus: Malaysia, Selangor, Ulu Gombak, University of Malaya's Field Study Center, 29 Nov 2004, Yee-Shin Tan, TYS 384 (Holotypus: KLU-M#89).



**Fig. 26.** *Marasmius ochropoides* (Holotype: TYS 384 = KLU-M#89). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. f. Caulocystidia. Bars: a = 10 mm, b-f = 10 µm.

*Pileus* 5-6 mm diam, convex, without an umbo, disc smooth, margin smooth to striatulate; surface dry, dull, hygrophanous, subvelutinous; light orange (5A4) to brownish orange (6C7-8), light brown (6D8) or reddish brown (8D8). *Lamellae* adnate, close (12-18) with 2 series of lamellulae, narrow, white to yellowish white, non-marginate. *Stipe* 11-21 × 0.5-1 mm, central, cylindrical, terete, equal, dry, dull, pruinose, non-insititious, white (4A2) at the apex, pale orangish white (5A3) at the base, with yellowish white mycelium.

*Basidiospores* (8-) 9-12 (-13) × 3-4 µm [ $x_{mr} = 10.5-10.6 \times 3.6-3.7$  µm,  $x_{mm} = 10.6 \pm 0.1 \times 3.7 \pm 0.1$  µm,  $Q = 2.5-3.7$ ,  $Q_{mr} = 2.9-3$ ,  $Q_{mm} = 2.9 \pm 0.1$ ,  $n = 23$  spores per 3 specimens], clavate to ellipsoid, smooth, hyaline, inamyloid. *Basidia* 25-28 × 6-7 µm, clavate, 4-spored. *Basidioles* 25-32 × 5-8 µm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (10-) 15-25 (-30) × 5-6 (-8) µm, cylindrical to clavate, hyaline, inamyloid, thin-walled; apical setulae only two to four per cell, distant, (9-) 10-18 (-20) × 2-3

µm, cylindrical to conical, obtuse, rarely forked, hyaline, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* weakly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 10-16 (-20) × (4-) 6-10 µm, cylindrical to clavate or broadly clavate, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae (6-) 9-18 (-25) × 0.5-1 (-1.5) µm, cylindrical to conical, rarely forked, yellow to brownish yellow, inamyloid, thick-walled. *Pileus trama* sub-parallel to interwoven; hyphae 4-6 µm diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 5-9 µm diam, cylindrical, hyaline, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-7 µm diam, parallel, cylindrical, smooth, light yellow (apex) to yellow (base), weakly dextrinoid to dextrinoid, thick-walled (-1 µm); medullary hyphae 5-11 µm diam, parallel, cylindrical, smooth, hyaline, dextrinoid, thick-walled, non-gelatinous. *Caulocystidia* common, numerous, 23-100<sup>+</sup> ×

4-7  $\mu\text{m}$  diam, cylindrical to clavate, rarely lobed, obtuse, hyaline, dextrinoid, thick-walled (-0.5  $\mu\text{m}$ ) or apically thin-walled. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Malaysia (Selangor, Selayang).

*Material examined:* Malaysia, Selangor, University of Malaya's Field Study Center, N 03°19.500', E 101°45.167', elev. ca 240 m, 29 Nov 2004, Yee-Shin Tan, TYS 384 (**Holotype:** KLU-M#89; **Isotype:** SFSU); Selayang, Kanching Forest Reserve, N 03° 17.958', E 101°37.151'. 8 Jan 2005, Amy Honan, TYS 416 (KLU-M#88, SFSU); same location, 8 Jan 2005, Yee-Shin Tan, TYS 351 (KLU-M#134, SFSU).

*Notes:* *Marasmius ochropoides* is characterized by a smooth pileus ranging in colour from pale reddish brown to brownish orange or orange when fresh but soon fades to light orange overall; close (12-18) lamellae; a subglabrous stipe coloured white above and pale orangish white at the base; basidiospores 9-12  $\times$  3-4  $\mu\text{m}$  with mean 10.6  $\times$  3.7  $\mu\text{m}$ ; unusual cheilocystidia that have only 2-4 conical, hyaline setulae up to 20  $\mu\text{m}$  long; and scattered, thin- to thick-walled, hyaline, obtuse, cylindrical caulocystidia. The new species is phenetically closest to *M. ochropus* Singer from Africa, but the latter species differs in forming typical *Siccus*-type cheilocystidia with numerous, short (1-7  $\mu\text{m}$ ) setulae, and lacks caulocystidia (Pegler, 1977; Antonín, 2007). It is also similar to *M. ochroleucus* Desjardin & E. Horak from New Caledonia, but that species also has typical *Siccus*-type cheilocystidia with numerous, shorter (1-8  $\mu\text{m}$ ) setulae and has a distinctly but minutely velutinous stipe with numerous, often acutely cylindrical caulocystidia (Desjardin and Horak, 1997).

22. *Marasmius iras*. Y.S. Tan & Desjardin, **sp. nov.** (Fig. 27, Plate 2H)

MycoBank: MB512628

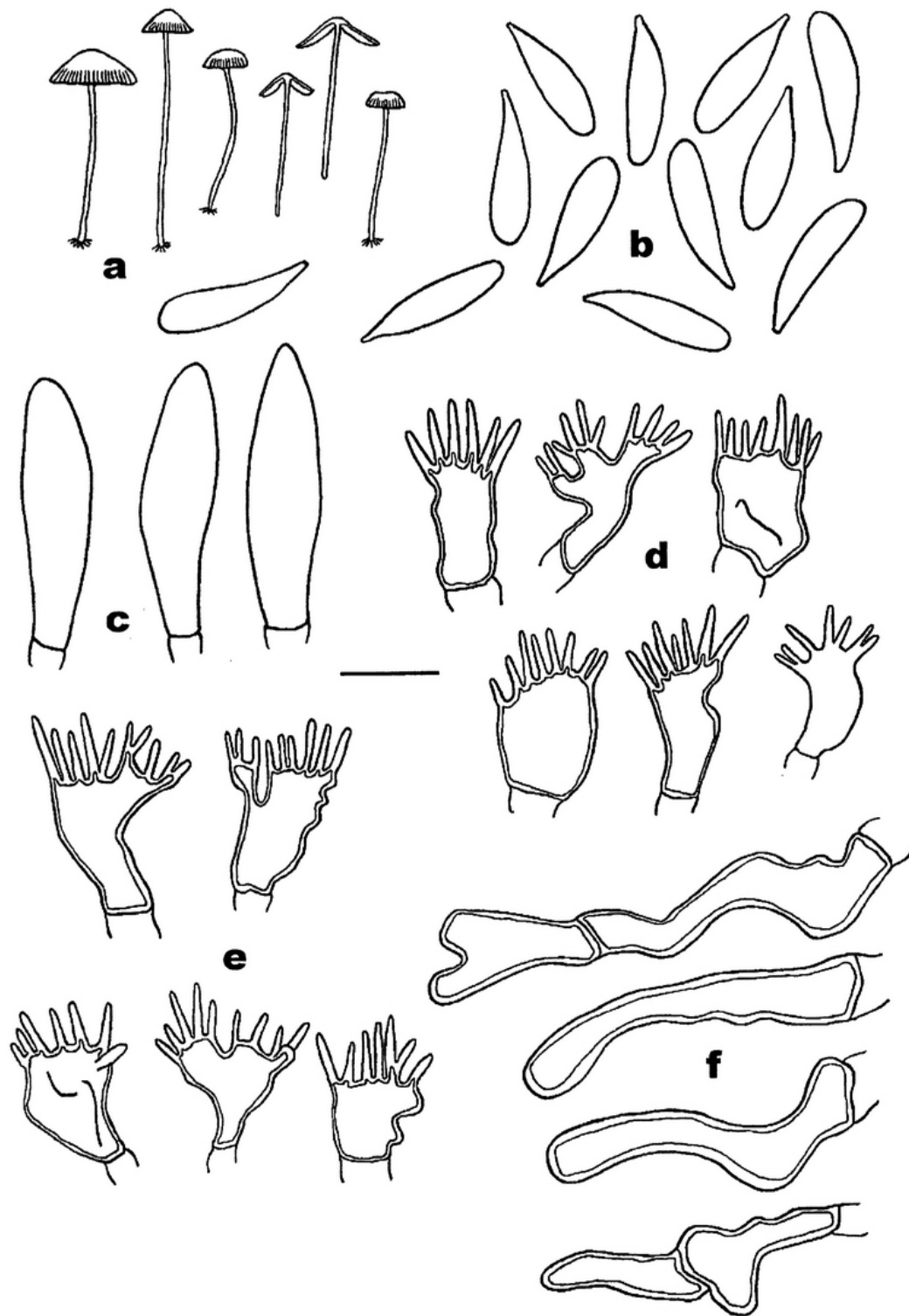
*Etymology:* iras (Malaysian) – resembling, referring to its similarity to *Marasmius musicolor*.

Pileus 6-18 mm latus, convexus vel plano-convexus, ruguloso-striatus, subvelutinus, brunneus vel aurantio-brunneus. Lamellae adnatae, densae (14-16), haud intervenosae, angustae, albidae, haud marginatae. Stipes 21-45  $\times$  1 mm, cylindricus, pruinosis, haud insititius, apicaliter stramineus, basim aurantio-brunneus, ad basim tomento aurantio-brunneo affixus. Basidiosporae 13-16  $\times$  3-4  $\mu\text{m}$ , clavatae, leves, hyalinae, inamyloideae. Cheilocystidia typi Sicci, 12-16  $\times$  4-7  $\mu\text{m}$ ,

cylindracea vel clavata, hyalina; setulae ad apicem 4-6  $\times$  0.5-1  $\mu\text{m}$ , densae, cylindricae vel conicae, subacutae vel acutae, fulvae, inamyloideae, tenui- vel crasse-tunicatae. Pleurocystidia nulla. Pileipellis hymeniformis, typi Sicci, cellulae 9-12  $\times$  6-8  $\mu\text{m}$ , cylindricae vel clavatae, pallide fulvae vel brunneae, inamyloideae, crasse-tunicatae; setulae ad apicem 4-6  $\times$  0.5-1  $\mu\text{m}$ , cylindricae vel conicae, subacutae, brunneae, inamyloideae, crasse-tunicatae. Caulocystidia 30-50  $\times$  5-8  $\mu\text{m}$ , cylindricae vel clavatae, apicaliter diverticulata, hyalinae vel stramineae, crasse-tunicatae. Fibulae presentes. Gregarius, ad folia putrida plantarum dicotyledonearum. Holotypus: Malaysia, Selangor, Ulu Gombak, University of Malaya's Field Study Center, 31 May 2005, Yee-Shin Tan, TYS 483 (Holotypus: KLU-M#73).

*Pileus* 6-18 mm diam, convex when young, becoming broadly convex to plano-convex in age; disc depressed, smooth; margin rugulose-striate; surface dry, dull, hygrophorous, subvelutinous; brown (6E7) with dark brown (8E7) disc when young, in age becoming brownish orange (5B5) to grayish orange with a brown (6E7) disc. *Lamellae* adnate, close to crowded (14-16) with 3-4 series of lamellulae, not intervenose, narrow, light yellow (3A4) with concolorous or pale brown edge. *Stipe* 21-45  $\times$  1 mm, central, terete, cylindrical, equal, dry, dull, pruinose, non-insititious, yellowish white (4A2) at the apex, gradually grading to light brown or brownish orange at the base, with strigose brownish orange basal mycelium. *Odor* pleasant.

*Basidiospores* (10-) 13-16  $\times$  3-4 (-4.5)  $\mu\text{m}$  [ $x = 14.1 \pm 1.6 \times 3.7 \pm 0.4 \mu\text{m}$ ,  $Q = 2.6-5.3$ ,  $Q_m = 3.8 \pm 0.6$ ,  $n = 31$  spores], elongate-lacrymoid to clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* (21-) 26-29 (-38)  $\times$  5-8 (-9)  $\mu\text{m}$ , fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (7-) 12-16 (-17)  $\times$  (3-) 4-7 (-9)  $\mu\text{m}$ , cylindrical to clavate or broadly clavate, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae 4-6 (-7)  $\times$  0.5-1  $\mu\text{m}$ , crowded, cylindrical to conical, subacute to acute, rarely forked, yellow, inamyloid, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* weakly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (7-) 9-12 (-16)  $\times$  6-8  $\mu\text{m}$ , cylindrical to clavate or broadly clavate, rarely lobed, light yellow to light brown, inamyloid, thick-walled; apical setulae



**Fig. 27.** *Marasmius iras* (Holotype: TYS 483 = KLU-M#73). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. f. Caulocystidia. Bars: a = 10 mm, b-f = 10  $\mu$ m.

4-6 (-7)  $\times$  0.5-1  $\mu$ m., cylindrical to conical, rarely forked, subacute, brownish yellow to brown, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae 2-4  $\mu$ m diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 3-4  $\mu$ m diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic;

cortical hyphae 4-5  $\mu$ m diam, parallel, cylindrical, smooth, brownish yellow (apex) to brown (base), weakly dextrinoid, thick-walled; medullary hyphae 3-9  $\mu$ m diam, parallel, cylindrical, smooth, hyaline, dextrinoid, thin-walled. *Caulocystidia* scattered in clusters, (25-) 30-50 (-65)  $\times$  (4-) 5-8 (-9)  $\mu$ m, irregularly cylindrical to clavate, often apically split or

diverticulate, hyaline to light yellow, inamyloid, thick-walled. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves and twigs. Malaysia (Selangor).

*Material examined:* Malaysia, Selangor, Ulu Gombak, University of Malaya's Field Study Centre, 31 May 2005, Yee-Shin Tan, TYS 483 (**Holotype:** KLU-M#73; **Isotype:** SFSU).

*Notes:* *Marasmius iras* is characterized by the following suite of features: a convex to plano-convex pileus 6-18 mm diam with a depressed, smooth, dark brown disc and rugulose-striate, dull brown margin; close (14-16) lamellae with 3-4 series of lamellulae coloured yellowish white with concolorous or pale brown edges; a stipe 20-45 × 1 mm that is pruinose overall with a pale yellowish white apex and brownish orange base; basidiospores 12-16 × 3-4.5 μm with mean 14.1 × 3.7 μm; no pleurocystidia; *Siccus*-type cheilocystidia and pileipellis broom cells with setulae 4-6 μm long; cylindrical, obtuse, non-setulose caulocystidia and an absence of *Siccus*-type broom cells on the stipe; and growth on dicotyledonous leaves. The new species is similar to *M. convoluticeps* Singer from Brazil, and *M. musicolor* from Malaysia. *Marasmius convoluticeps* differs in forming a convoluted, gyrose, venose-rugulose pileus coloured bright ferruginous, a dark brown stipe, broom cell setulae 4.5-12 μm long, and grows on dead wood (Singer, 1976). *Marasmius musicolor* differs in forming a banana yellow pileus, slightly longer basidiospores (mean 16.1 × 3.9 μm), more highly branched caulocystidia, and grows on twigs.

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

Type species: *Marasmius leoninus* Berk.

23. *Marasmius* aff. *leoninus* Berk., Hooker's J. Bot. 8: 135. 1856. (Fig. 28, Plate 2 C)

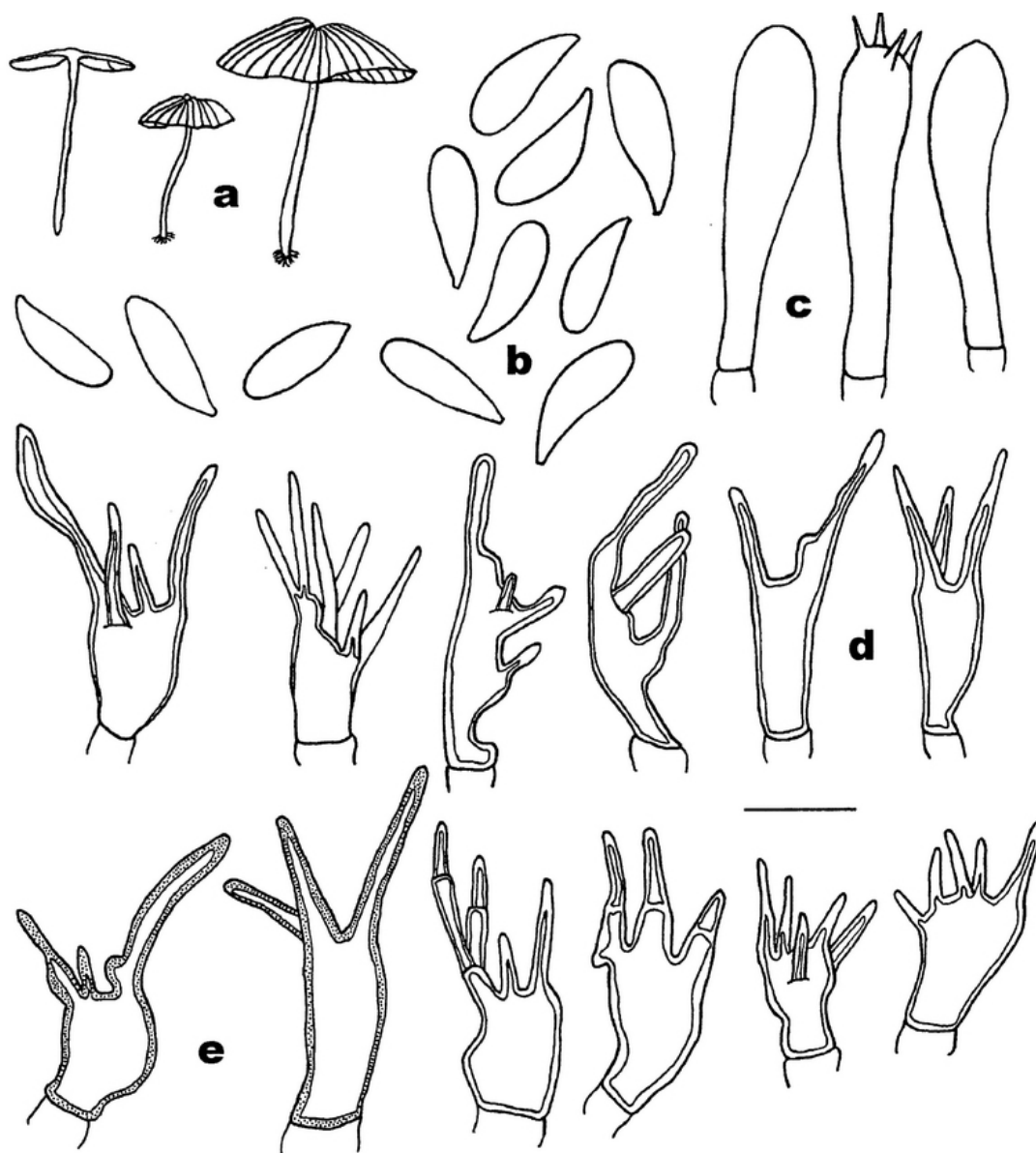
*Pileus* 18-34 mm diam, convex to broadly convex; disc depressed, rugulose; margin striate to sulcate; surface dry, dull, velutinous; pale orange (5A3) to pale yellow (4A3) with a brown (6E7) disc. *Lamellae* adnate, subdistant to close (13-15) with 3 series of lamellulae, not intervenose, broad, yellowish

white (4A2), non-marginate. *Stipe* 22-35 × 1-2.5 mm, central, terete, equal, dry, dull, glabrous, non-insititious, yellowish white (4A2) at apex, dark brown at base, with light brown basal mycelium. *Odor* pleasant.

*Basidiospores* (9-) 10-12 (-14) × 3-4 μm [ $x = 11.4 \pm 1.1 \times 3.8 \pm 0.4 \mu\text{m}$ ,  $Q = 2.4-4$ ,  $Q_m = 3 \pm 0.4$ ,  $n = 26$  spores], narrowly cylindrical to clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* 28 × 7 μm, clavate, 4-spored. *Basidioles* 25-30 × 5-7 μm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body 8-18 (-20) × (4-) 5-8 (-10) μm, cylindrical to clavate or irregular in outline, rarely lobed, hyaline, inamyloid, thin- to thick-walled; apical setulae (8-) 11-16 (-27) × 1-2 (-3) μm, narrowly cylindrical to conical, rarely forked, light yellow, inamyloid, thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 7-12 (-17) × 5-8 (-10) μm, cylindrical to clavate or irregular in outline, rarely lobed, hyaline, inamyloid to weakly dextrinoid, thin- to thick-walled; apical setulae (5-) 6-12 (-17) × 1-1.5 (-2) μm, narrowly conical, obtuse, rarely forked, light yellow, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae 5-6 μm diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 5-8 μm diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 5-8 μm diam, parallel, cylindrical, smooth, light yellow (apex) to yellow (base), dextrinoid, thick-walled, non-gelatinous; medullary hyphae 3-5 μm, parallel, cylindrical, smooth, hyaline, inamyloid, thin-walled. *Caulocystidia* scattered, 5-26 (-40) × (1-) 2-5 μm, irregularly cylindrical to conical, some apically forked and setulae-like, plus a few scattered *Siccus*-type broom cells, hyaline to light yellow, inamyloid, thick-walled. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Malaysia (Selangor).

*Material examined:* Malaysia, Selangor, Selayang, Kanching Forest Reserve, N 03° 17.958', E 101° 37.151', elev. 110 m, 9 Jan 2005, collected by D.E. Desjardin, TYS 423 (KLU-M#78; SFSU).



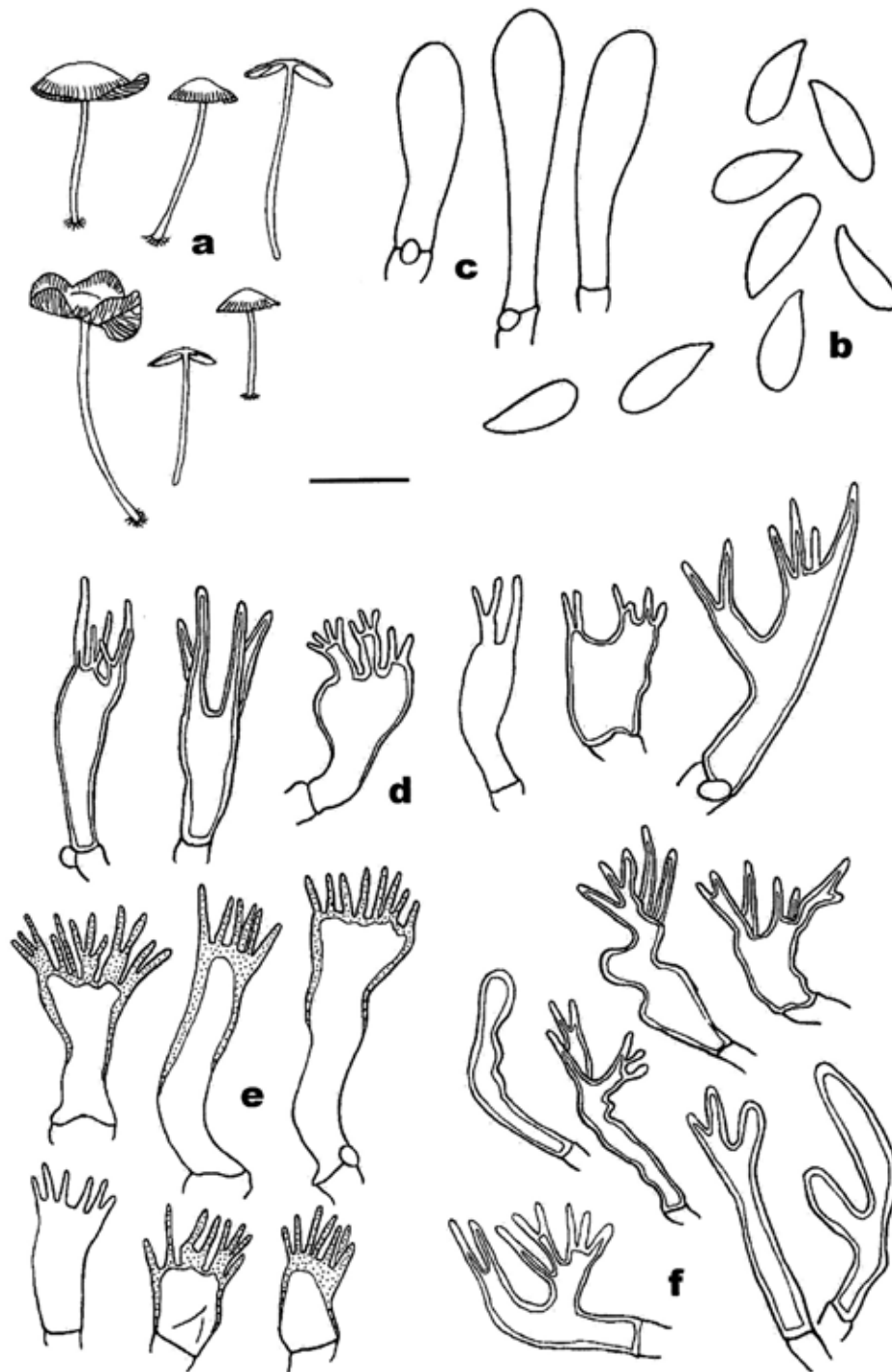
**Fig. 28.** *Marasmius* aff. *leoninus* (TYS 466 = KLU-M#78). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 20 mm, b-e = 10  $\mu$ m.

*Notes:* The Malaysian species is characterized by the following features: a large (18-34 mm diam) sulcate-depressed pileus with brown disc and pale orangish white margin; non-marginate, close to subdistant (13-15) lamellae with 3 series of lamellulae; a glabrous stipe 22-35  $\times$  1-2.5 mm with yellowish white apex and dark brown base; basidiospores 10-12  $\times$  3-4  $\mu$ m with mean 11.4  $\times$  3.8  $\mu$ m; no pleurocystidia; *Siccus*-type cheilocystidia with few setulae 8-27  $\times$  1-3  $\mu$ m; *Siccus*-type pileipellis broom cells with setulae 6-17  $\times$  1-1.5  $\mu$ m; and scattered caulocystidia that are simple to branched, acute, setulae-like outgrowths in combination with a few *Siccus*-type broom cells. Only one specimen is known

currently from Malaysia. It is closest to *M. leoninus* Berk. from Brazil, but the latter species forms fewer lamellae (7-12), has slightly smaller basidiospores (8.8-10  $\times$  2.8-3.4  $\mu$ m), and cheilocystidia with more numerous and much smaller setulae (3-8  $\mu$ m long) (Isotype FH!). Interestingly, the two taxa share the same stipitipellis anatomy. Until further specimens of this interesting taxon are discovered in Malaysia, we tentatively recognize the material as representing *M. leoninus*.

24. *Marasmius araucariae* var. *siccipes* Desjardin, Retn. & E. Horak, Sydowia 52: 173. 2000. (Fig. 29, Plate 2E)





**Fig. 29.** *Marasmius araucariae* var. *siccipes* (TYS 529 = KLU-M#41). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. f. Caulocystidia. Bars: a = 15 mm, b-f = 10  $\mu$ m.

Type: Indonesia, Java, West Java, Bogor Botanical Garden, 12 Jan 1999, A Retnowati 124 (BO!).

*Pileus* 10-24 mm diam, convex to campanulate when young, expanding to plano-convex or broadly convex with uplifted margin at maturity; disc rugulose; margin smooth to striate; surface dry, dull, velutinous; brownish orange (6C8, 7C8) to light brown (6D8) with darker disc. *Context* thin, orangish white.

*Lamellae* adnate, subdistant (13-16) with 3-5 series of lamellulae, not intervenose, pale yellow (4A3) with brownish orange edges. *Stipe* 20-50  $\times$  1 mm, central, terete, equal, tough, solid, dry, dull, glabrous to minutely pruinose, non-insititious, orange white (5A2) at the apex, grading to light yellow (4A3), grayish orange (5B6), brownish orange (6C6-7) to brown at the base, with grayish yellow (5B3) basal mycelium. *Odor* pleasant.

*Basidiospores* (8-) 9-11 (-12) × 3-4 (-5) μm [ $x_{mr} = 9.2-10.5 \times 3.1-3.6$  μm,  $x_{mm} = 9.6 \pm 0.5 \times 3.3 \pm 0.3$  μm,  $Q = 2.3-4.3$ ,  $Q_{mr} = 2.4-3.3$ ,  $Q_{mm} = 3 \pm 0.3$ ,  $n = 34$  spores per 3 specimens], ellipsoid to fusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* 17-30 × 5-8 μm, fusoid. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (5-) 6-18 (-22) × (3-) 5-8 μm, clavate to broadly clavate, vesiculose or irregular in outline, rarely lobed, hyaline to light yellow, inamyloid, thick-walled; apical setulae (2-) 3-13 × 0.5-1.5 μm, conical, acute, rarely forked, hyaline to brownish yellow or brown, inamyloid, thin to thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (6-) 10-22 (-30) × 5-8 (-10) μm, clavate to broadly clavate or irregular in outline, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae 5-8 × 1-1.5 μm, conical, acute, light yellow to brown, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae 4-10 μm diam, cylindrical, hyaline, weakly dextrinoid to dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 4-5 μm diam, cylindrical, hyaline to light yellow, dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 3-8 μm diam, parallel, cylindrical, smooth, brownish yellow to brown, inamyloid, thick-walled, non-gelatinous; medullary hyphae 3-5 μm, parallel, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipe* vestiture of two types of *caulocystidia*: a) *Siccus*-type broom cells with main body 15-40 × 6-13 μm, scattered, uncommon, clavate to cylindrical or irregular in outline, light yellow, inamyloid, thick-walled; apical setulae 5-6 × 1-2 μm, cylindrical to conical, yellow to brownish yellow, inamyloid, thick-walled; b) non-setulose cells, 12-27 × 3-7 μm, cylindrical to clavate, obtuse, yellow, inamyloid, thin to thick-walled. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Indonesia (Java), Malaysia (Selangor), Thailand.

*Material examined:* Malaysia, Selangor, Hulu Langat, Sungai Chongkak Forest Reserve, 6 Jan 2006, Yee-Shin Tan, TYS 529 (KLU-M#41, SFSU); same

location, 22 July 2005, Hong-Twu Chan, MY 38 (KLU-M#42, SFSU); same location, 16 May 2005, Yee-Shin Tan, TYS 463 (KLU-M#43, SFSU).

*Notes:* Distinctive features of this species include: a smooth to weakly striate pileus 10-24 mm diam coloured brown to brownish orange; subdistant (13-16) lamellae with 3 series of lamellulae; a glabrous to minutely pruinose stipe; basidiospores in the range 9-11 × 3-4 μm with mean 9.6 × 3.3 μm; *Siccus*-type cheilocystidia with acute setulae 3-13 × 0.5-1.5 μm; *Siccus*-type pileipellis broom cells with acute setulae 5-8 × 1-1.5 μm; two types of caulocystidia, viz., smooth clavate cells and small setulose broom cells; and growth on dicotyledonous leaves. The Malaysian population differs from the single specimen reported from Java only in having slightly smaller basidiospores (9.6 × 3.3 μm v.s. 11.7 × 3.8 μm, respectively).

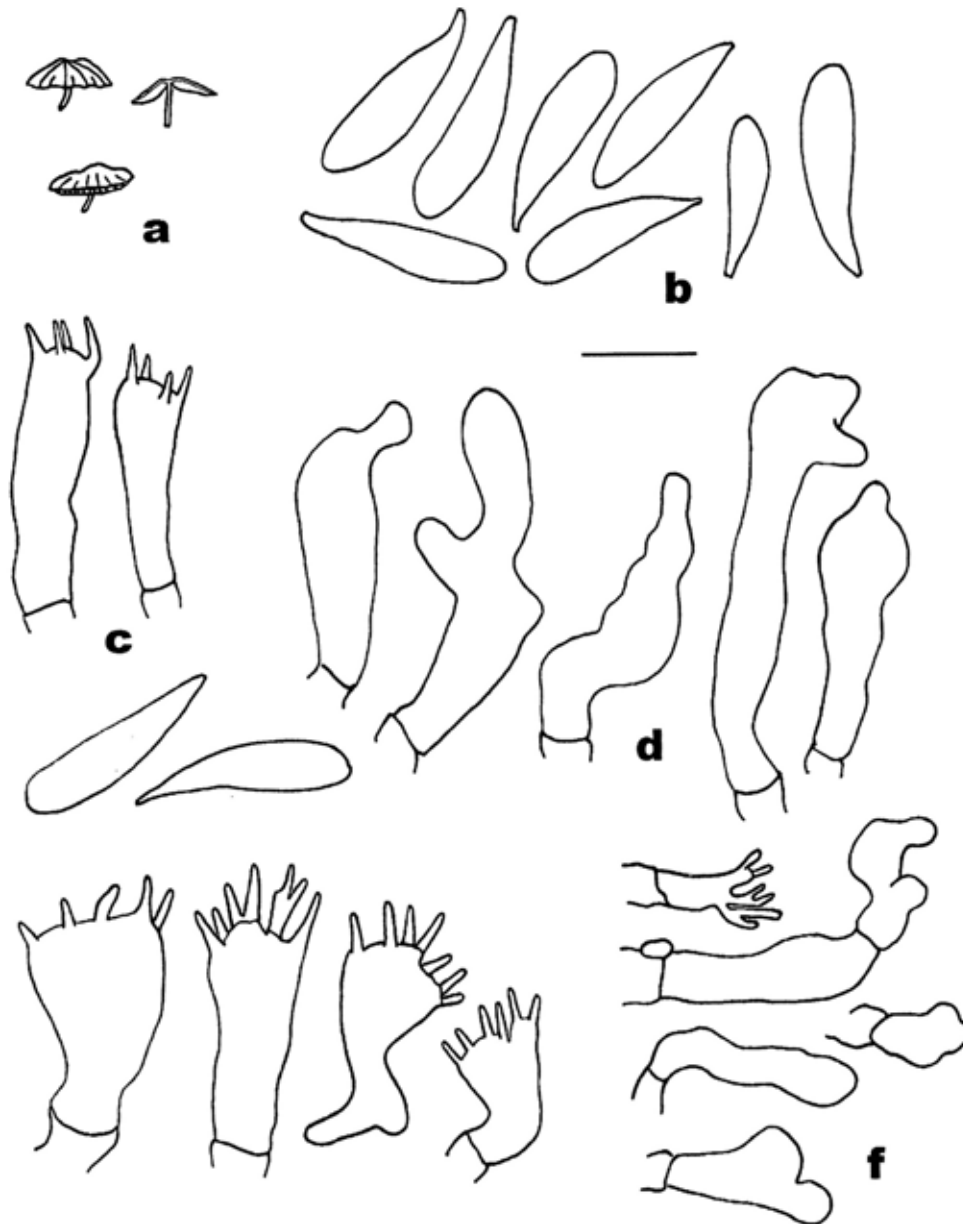
25. *Marasmius luteomarginatus* Desjardin, Retn. & E. Horak, *Sydowia* 52: 166. 2000.

(Fig. 30, Plate 2I)

Type: Indonesia, Java, West Java, Mt. Halimun National Park, loop trail from Cikaniki, 9 Jan. 1999, A. Retnowati 110 (BO!).

*Pileus* 3-9 mm diam, convex to broadly convex, umbilicate; margin striate to sulcate; surface dry, dull, minutely velutinous; orange (6B7-8) when young, in age fading to light orange (5A5) or grayish orange (5B5-6). *Lamellae* adnate, subdistant (7-10) with 2 series of lamellulae, orangish white with yellow edges. *Stipe* 2-3.5 × 1 mm, mostly eccentric when young, in age central, cylindrical, terete, equal, dry, dull, glabrous, non-insititious, orangish white at the apex, brownish orange (6C7-8) at the base, with grayish orange basal tomentum. *Odor* none.

*Basidiospores* (14-) 16-20 × (3.5-) 4-5 μm [ $x = 17.9 \pm 1.8 \times 4.2 \pm 0.4$  μm,  $Q = 3.5-5.1$ ,  $Q_m = 4.1 \pm 0.9$ ,  $n = 28$  spores], elongate-lacrymoid to clavate, hyaline, smooth, inamyloid. *Basidia* not observed. *Basidioles* 25-36 × 7.5-10 μm, fusoid to clavate. *Cheilocystidia* abundant, 25-40 × 4.8-8 μm, irregularly cylindrical to sinuous, often forked or with a broad lateral outgrowth, hyaline, inamyloid, thin-walled, with reddish brown resinous exudates soluble in 3% KOH. *Pleurocystidia* absent. *Pileipellis* weakly



**Fig. 30.** *Marasmius luteomarginatus* (TYS 477= KLU-M#3). a. Basidiomes. b. Basidiospores. c. Basidia. d. Cheilocystidia. e. Pileipellis. f. Caulocystidia. Bars: a = 10 mm, b-f = 10  $\mu$ m.

mottled to mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 8-20  $\times$  8-10 (-13)  $\mu$ m, cylindrical to clavate, broadly clavate or irregular in outline, rarely lobed, light yellow, inamyloid to weakly dextrinoid, thin- to thick-walled; apical setulae 2-6  $\times$  0.5-1  $\mu$ m, cylindrical to conical, rarely forked, yellow, weakly dextrinoid, thick-walled. *Pileus trama* subparallel; hyphae 4-6  $\mu$ m diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 4-5  $\mu$ m diam, cylindrical, hyaline to light yellow, weakly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-6.5  $\mu$ m diam, parallel, cylindrical,

smooth, light yellow to light brown, weakly dextrinoid to dextrinoid, thick-walled (-1  $\mu$ m); medullary hyphae 3-4  $\mu$ m diam, parallel, cylindrical, smooth, hyaline, weakly dextrinoid, thin-walled. *Caulocystidia* scattered, composed of two types of cells: a) rare *Siccus*-type broom cells with main body 6-8  $\times$  5-7  $\mu$ m, cylindrical to conical, hyaline, inamyloid, thin-walled; apical setulae 2-3  $\times$  1  $\mu$ m, narrowly cylindrical to clavate, obtuse to subacute, hyaline, inamyloid, thin-walled; b) non-setulose cells like the cheilocystidia, 12-22  $\times$  3.2-6.5  $\mu$ m, clavate, hyaline, inamyloid, thin-walled. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on leaves of palm. Indonesia (Java), Malaysia (Selangor).

*Material examined:* Malaysia, Selangor, Pangsun, Gunung Nuang Forest Reserve, N 03° 12.593', E 101° 52.575', 319 m, 17 May 2005, Yee-Shin Tan, TYS 477 (KLU-M #3, SFSU).

*Notes:* This is the second known specimen of *M. luteomarginatus* and extends the range from Mt. Halimun, Java northward to Selangor, Malaysia. The small orange basidiomes with yellow-marginate lamellae and short eccentric stipe are distinctive. The thin-walled, irregularly cylindrical cheilocystidia, unusual in *Marasmius*, are presumably exudative because dried specimens have lamellar edges with dark reddish brown resinous incrustations.

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

26. *Marasmius jasminodorus* Wannathes, Desjardin & Lumyong, Fungal Diversity 37 (This volume) (Fig. 31)

Type: Thailand, Chiang Mai Prov., Mok Fa waterfall on Hwy 1095, 1 August 2003, N. Wannathes 067 (CMU!).

*Pileus* 2-11 mm diam, convex to campanulate; margin smooth; surface dry, dull, subvelutinous; brownish orange (6C8, 7C7-8) to orangish red (8B6) with darker disc. *Lamellae* adnate, close (14-16) with 2-3 series of lamellulae, not intervenose, yellowish white with orange edges. *Stipe* 16-17 × 0.5-1 mm, central, terete, equal, tough, dry, dull, glabrous to pruinose, non-insititious with brownish orange basal mycelium; yellowish white at apex and brownish orange at base. *Odor* pleasant, floral, like jasmine tea.

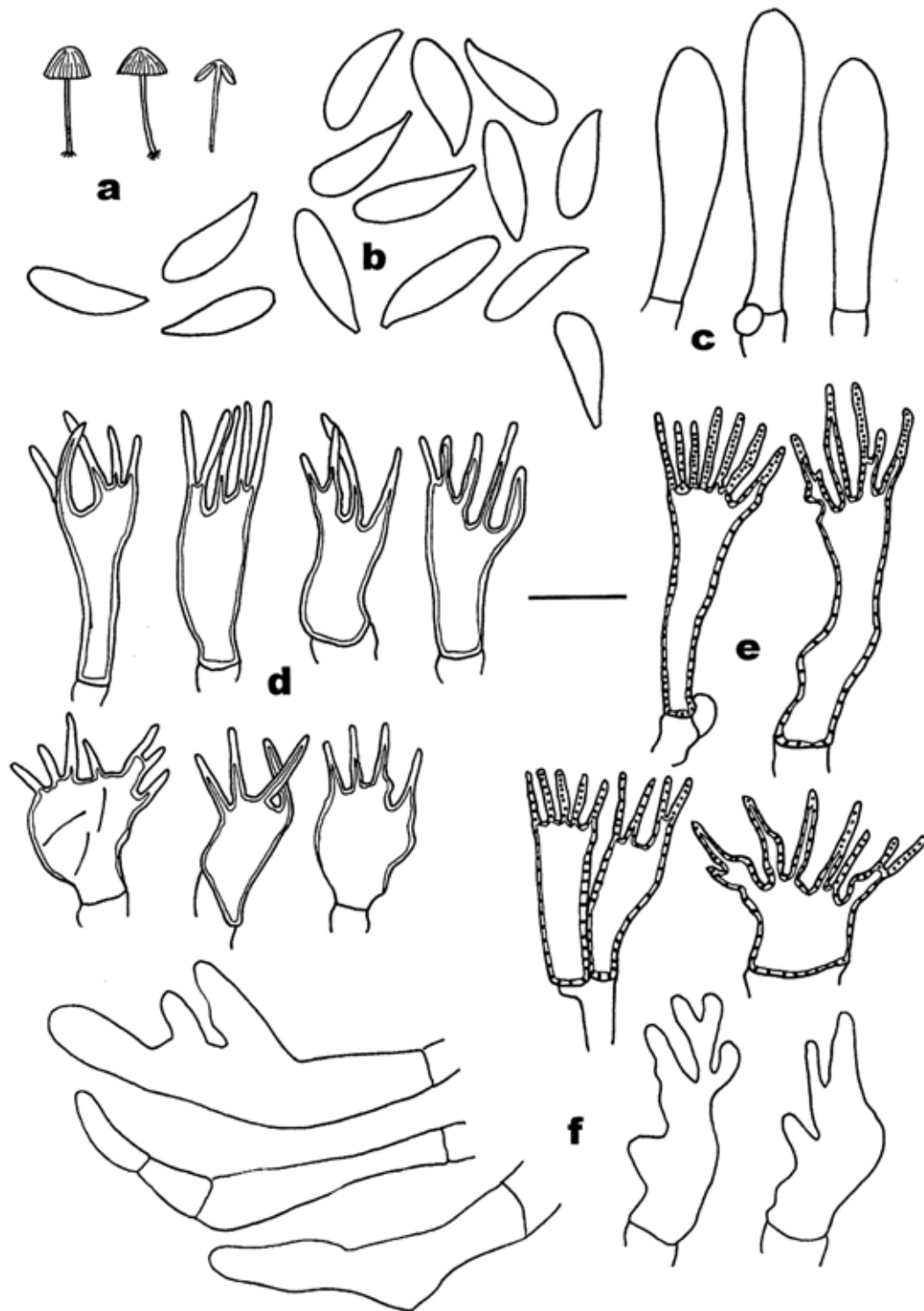
*Basidiospores* (11-) 12-14 (-15) × (3.5-) 4-4.5 (-5) μm [ $\bar{x} = 12.7 \pm 1 \times 4 \pm 0.3 \mu\text{m}$ ,  $Q = 2.7-3.6$ ,  $Q_m = 3.1 \pm 0.2$ ,  $n = 31$  spores], narrowly ellipsoid to clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* 23-30 × 5-8 μm, fusoid. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (7-) 9-20 (-30) × (6-) 7-10 (-11) μm, cylindrical, clavate to broadly clavate, vesiculose or some with

irregular outline, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae (5-) 6-10 × 1-1.5 μm, acute to subacute, rarely forked, light yellow, inamyloid, thin to thick-walled. *Pleurocystidia* absent. *Pileipellis* strongly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (10-) 11-22 (-29) × (5-) 6-11 μm, clavate to broadly clavate or irregular in outline, rarely lobed, light yellow, inamyloid, thin- to thick-walled; apical setulae (5-) 6-10 (-12) × 0.5-1 μm, acute to subacute, brown, inamyloid, thick-walled. *Pileus trama* interwoven, hyphae 3-6 μm diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular to subparallel, hyphae 5-8 μm diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-9 μm diam, parallel, cylindrical, smooth, light yellow (apex) to brownish yellow (base), dextrinoid, thick-walled (1 μm), non-gelatinous; medullary hyphae 6-11 μm, parallel, cylindrical, smooth, hyaline, dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* scattered, composed of two types of cells: a) *Siccus*-type broom cells similar to the cheilocystidia; b) non-setulose cells 15-30 × 3-10 μm, common, cylindrical or ventricose, some apically split or diverticulate, light yellow, inamyloid, thin-walled. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Malaysia (Kedah), Thailand.

*Material examined:* Malaysia, Kedah, Langkawi Island, Matchinchang Forest Reserve, 1 September 2004, Yee-Shin Tan, TYS 333 (KLU-M#138, SFSU).

*Notes:* *Marasmius jasminodorus* is characterized by a relatively small, smooth, brownish orange to orangish red pileus, close, orange-marginate lamellae, a minutely pruinose stipe with small, cylindrical caulocystidia and *Siccus*-type broom cells, relatively short basidiospores with mean length 12.7 μm, *Siccus*-type cheilocystidia and pileipellis broom cells with acute setulae 6-10 mm long, an absence of pleurocystidia, and growth on dicotyledonous leaves. The most distinctive feature is a strong pleasant odor of jasmine tea.



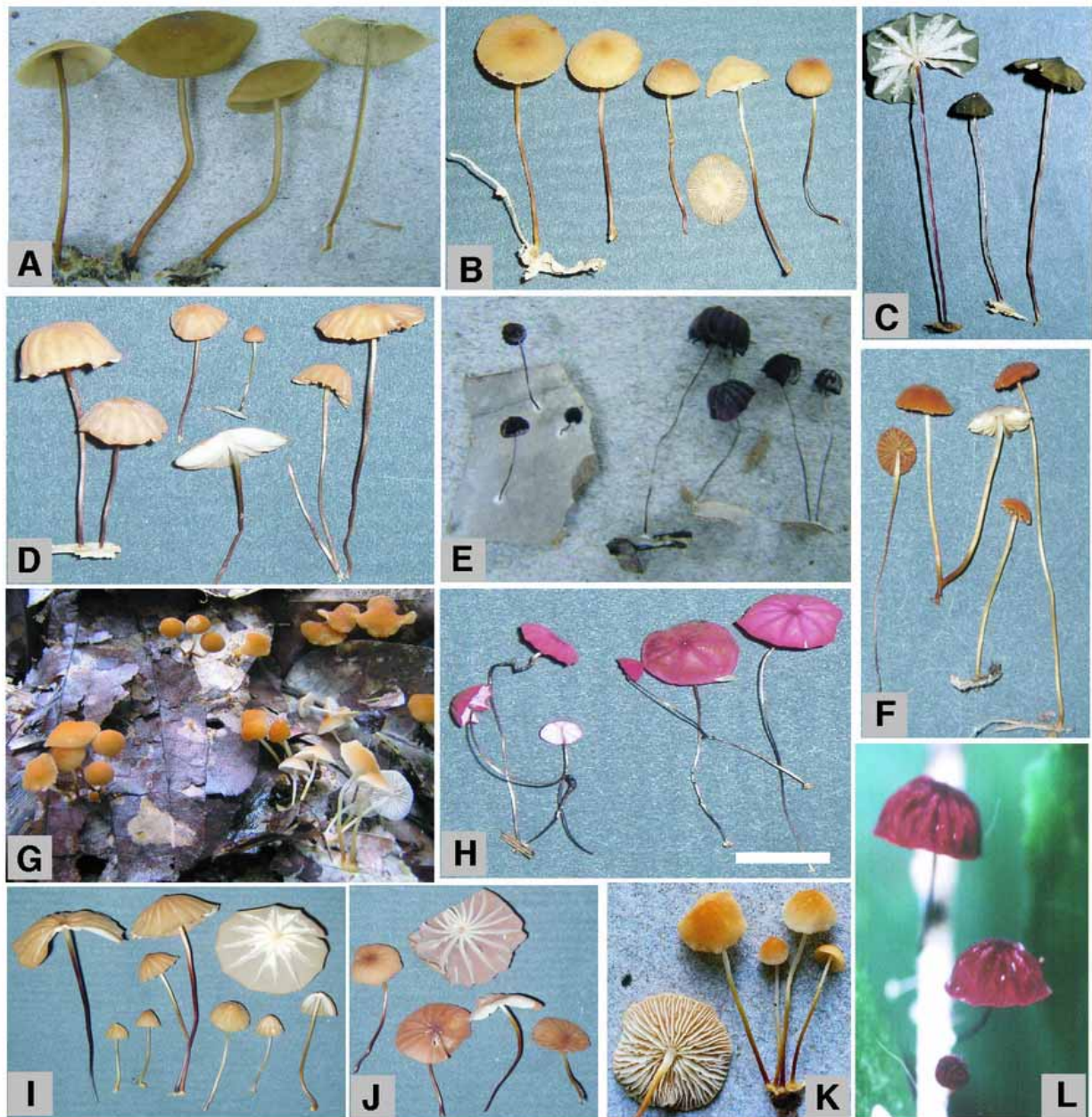
**Fig. 31.** *Marasmius jasminodorus* (TYS 333 = KLU-M#138). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. f. Caulocystidia. Bars: a = 10 mm, b-d = 10  $\mu$ m.

27. *Marasmius angustilamellatus* Y.S. Tan & Desjardin, **sp. nov.** (Fig. 32, Plate 4.3A)  
Mycobank: MB512629

*Etyymology*: *angusti-* (Latin) = narrow; *-lamellatus* (Latin) = lamellae, referring to the very narrow lamellae.

*Pileus* 18-50 mm latus, convexus vel plano-convexus, haud striatus, subvelutinus, fulvae-brunneus

vel pallide brunneus ad centrum ater. Lamellae adnatae, densae (24-40), angustae, pallide brunneae, haud marginatae. Stipes 27-63  $\times$  1-2 mm, cylindricus, leves, glabrus, haud insititius, apicaliter fulvae-brunneus, basim atrobrunneus, ad basim tomento aurantio strigosoque affixus. Basidiosporae 8-12  $\times$  3.5-4  $\mu$ m, ellipsoideae vel subclavatae, hyalinae, inamyloideae. Cheilocystidia typi Sicci, 10-16  $\times$  7-11  $\mu$ m, cylindracea

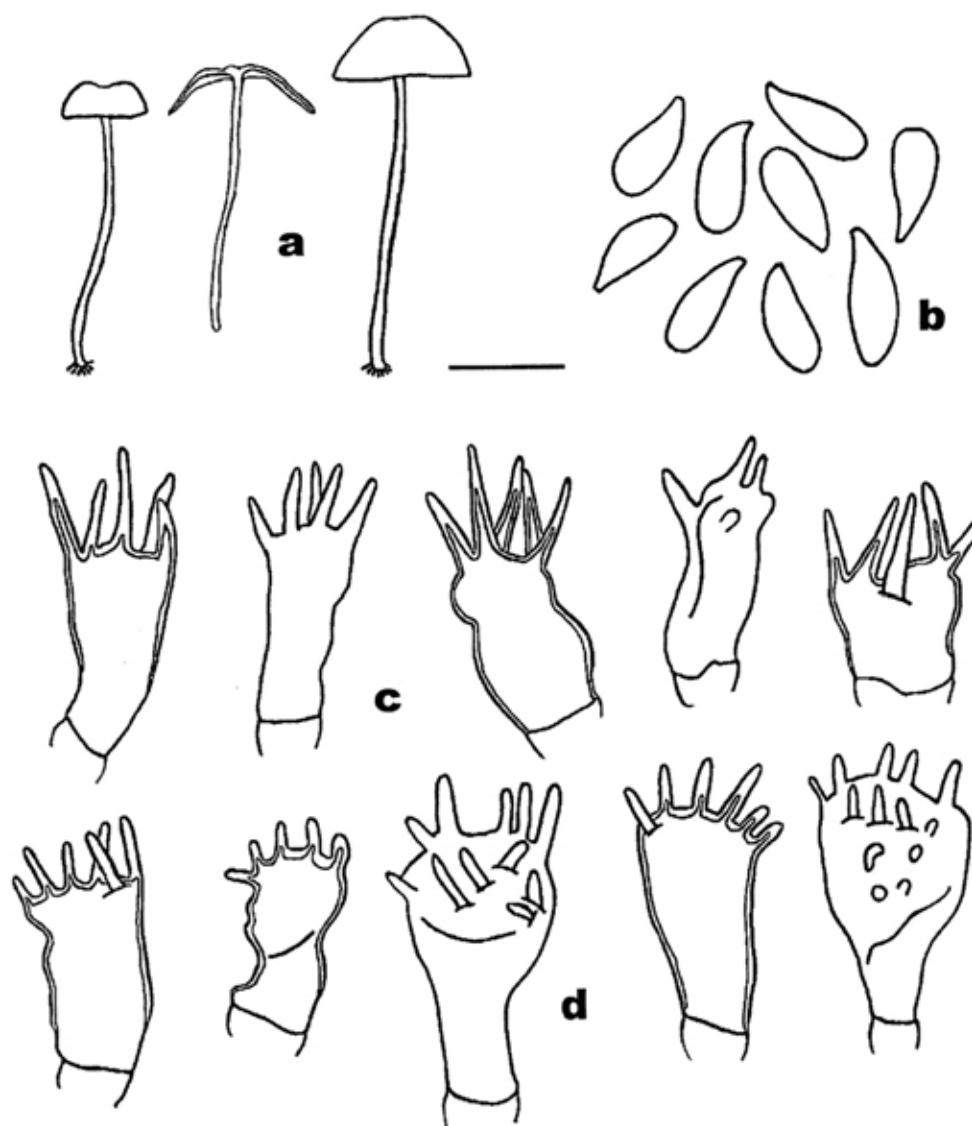


**Plate 3.** *Marasmius* s.s. in section *Sicci*. A: *Marasmius angustilamellatus* (x 0.5); B: *Marasmius acerosus* (x 1); C: *Marasmius olivascens* (x 1); D: *Marasmius persicinus* (x 0.5); E: *Marasmius haematocephalus* (x 1); F: *Marasmius florideus* (x 1); G: *Marasmius abundans* var. *abundans* (x 0.25); H: *Marasmius distantifolius* (x 2); I: *Marasmius adhaesus* (x 0.5); J: *Marasmius selangorensis* (x 0.5); K: *Marasmius abundans* var. *aurantiacus* (x 0.5); L: *Marasmius aratus* (x 1).

vel clavata, straminea; setulae ad apicem  $3-8 \times 1-2 \mu\text{m}$ , conicae, subcutae vel obtusae, hyalinae vel stramineae, inamyloideae, tenui- vel crasse-tunicatae. Pleurocystidia nulla. Pileipellis hymeniformis, typi *Sicci*, cellulae  $15-22 \times 8.5-11 \mu\text{m}$ , cylindricae, clavatae vel irregulare, stramineae, inamyloideae, crasse-tunicatae; setulae ad apicem  $3-6 \times 0.5-1 \mu\text{m}$ , cylindricae vel conicae, subcutae, stramineae, inamyloideae, crasse-tunicatae. Caulocystidia nulla. Fibulae presentes. Solitarius vel gregarius ad folia putrida plantarum dicotyledonearum. Holotypus: Malaysia, Selangor, Ulu Gombak,

University of Malaya's Field Study Centre, 5 Sept 2005, Yee-Shin Tan, TYS 524 (Holotypus: KLU-M#36).

*Pileus* 18-50 mm diam, convex when young, becoming broadly convex to plano-convex in age; margin smooth (non-striate); surface dull, dry, hygrophanous, subvelutinous; yellowish brown (5E8, F8) to grayish orange (5B4), brownish orange (5C5) or light brown (5D5-7) with black disc. *Lamellae* adnate, crowded (24-40) with 3-7 series of lamellulae,



**Fig. 32.** *Marasmius angustilamellatus* (Holotype: TYS 524 = KLU-M#33). a. Basidiomes. b. Basidiospores. c. Cheilocystidia. d. Pileipellis. Bars: a = 20 mm, b-d = 10  $\mu$ m.

very narrow (1 mm), light brown, non-marginate. *Stipe* 27-63  $\times$  1-2 mm, central, terete, equal, cylindrical, tough, wiry, dry, dull, glabrous, hollow, non-insititious, yellowish brown (5E5-8) at the apex, dark brown (6F8) at the base, with strigose light orange basal mycelium. *Odor* not distinctive.

*Basidiospores* 8-12 (-14)  $\times$  3.5-4 (-4.5)  $\mu$ m [ $\bar{x}$  = 9.9  $\pm$  1.7  $\times$  3.8  $\pm$  0.4  $\mu$ m,  $Q$  = 2-3.5,  $Q_m$  = 2.6  $\pm$  0.3,  $n$  = 15 spores (observed in only one specimen; other specimens yielded no spores)], elongate-ellipsoid to subclavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* fusoid. Lamellar edge sterile, with a broad band of cheilocystidia; *cheilocystidia* composed of *Siccus*-type broom cells; main body (7-) 10-16  $\times$  7-11  $\mu$ m, cylindrical to clavate or broadly

clavate, rarely lobed, light yellow, inamyloid, thick-walled; apical setulae (2-) 3-8 (-10)  $\times$  1-2  $\mu$ m, not crowded, conical, subacute to obtuse, rarely forked, hyaline to light yellow, inamyloid, thin to thick-walled. *Pleurocystidia* absent. *Pileipellis* weakly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (10-) 15-22 (-26)  $\times$  (7-) 8.5-11 (-12)  $\mu$ m, cylindrical to clavate, broadly clavate or irregular in outline, rarely lobed, light yellow, inamyloid to weakly dextrinoid, thick-walled; apical setulae (2-) 3-6  $\times$  0.5-1 (1.5)  $\mu$ m, cylindrical or conical, rarely forked, subacute, light yellow, inamyloid to weakly dextrinoid, thick-walled. *Pileus trama* interwoven; hyphae 2.5-5  $\mu$ m diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 3-5  $\mu$ m diam,

cylindrical, hyaline to light yellow, strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-6 µm diam, parallel, cylindrical, smooth, orangish yellow (apex) to brownish yellow (base), weakly dextrinoid, thick-walled, non-gelatinous; medullary hyphae 5-10 µm diam, parallel, cylindrical, smooth, light yellow, strongly dextrinoid, thick-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* solitary and gregarious on undetermined dicotyledonous leaves. Malaysia (Selangor).

*Material examined:* Malaysia, Selangor, Hulu Langat, Sungai Chongkak Forest Reserve, 6 Jan 2006, Dennis Desjardin, TYS 528 (KLU-M#37, SFSU); Selangor, Ulu Gombak, University of Malaya's Field Study Centre, 5 Sept 2005, Yee-Shin Tan, TYS 524 (**Holotype:** KLU-M#36; **Isotype:** SFSU); Selangor, Selayang, Kanching Forest Reserve, N 03° 17.958', E 101° 37.151', elev. 110m, 9 Jan 2005, Yee-Shin Tan, TYS 437 (KLU-M#35, SFSU).

*Notes:* The new species is distinctive because of the following characters: a relative large (18-50 mm diam), smooth pileus coloured yellowish brown with a black disc; very crowded and very narrow, non-marginate lamellae; basidiospores in the range 8-14 × 3.5-4.5 µm with mean 9.9 × 3.8 µm; short and broad cheilocystidia (7-16 × 7-11 µm); an absence of pleurocystidia and caulocystidia; and growth on dicotyledonous leaves. *Marasmius angustilamellatus* is most closely similar to *M. corrugatus* (Pat.) P. Sydow from the Greater Antilles, and *M. xestocephalus* Singer and *M. xestocephaloides* Antonín from Africa. *Marasmius corrugatus* differs in forming a rugulose-corrugate pileus coloured reddish cinnamon to chestnut brown, and is New World in origin. *Marasmius xestocephalus* and *X. xestocephaloides* both differ in forming prominent caulocystidia.

28. *Marasmius olivascens* Y.S. Tan & Desjardin, **sp. nov.** (Fig. 33, Plate 3C)  
MycoBank: MB 512630

*Etymology:* *olivascens* (Latin) = becoming olive coloured, referring to the pigmentation of the pileus.

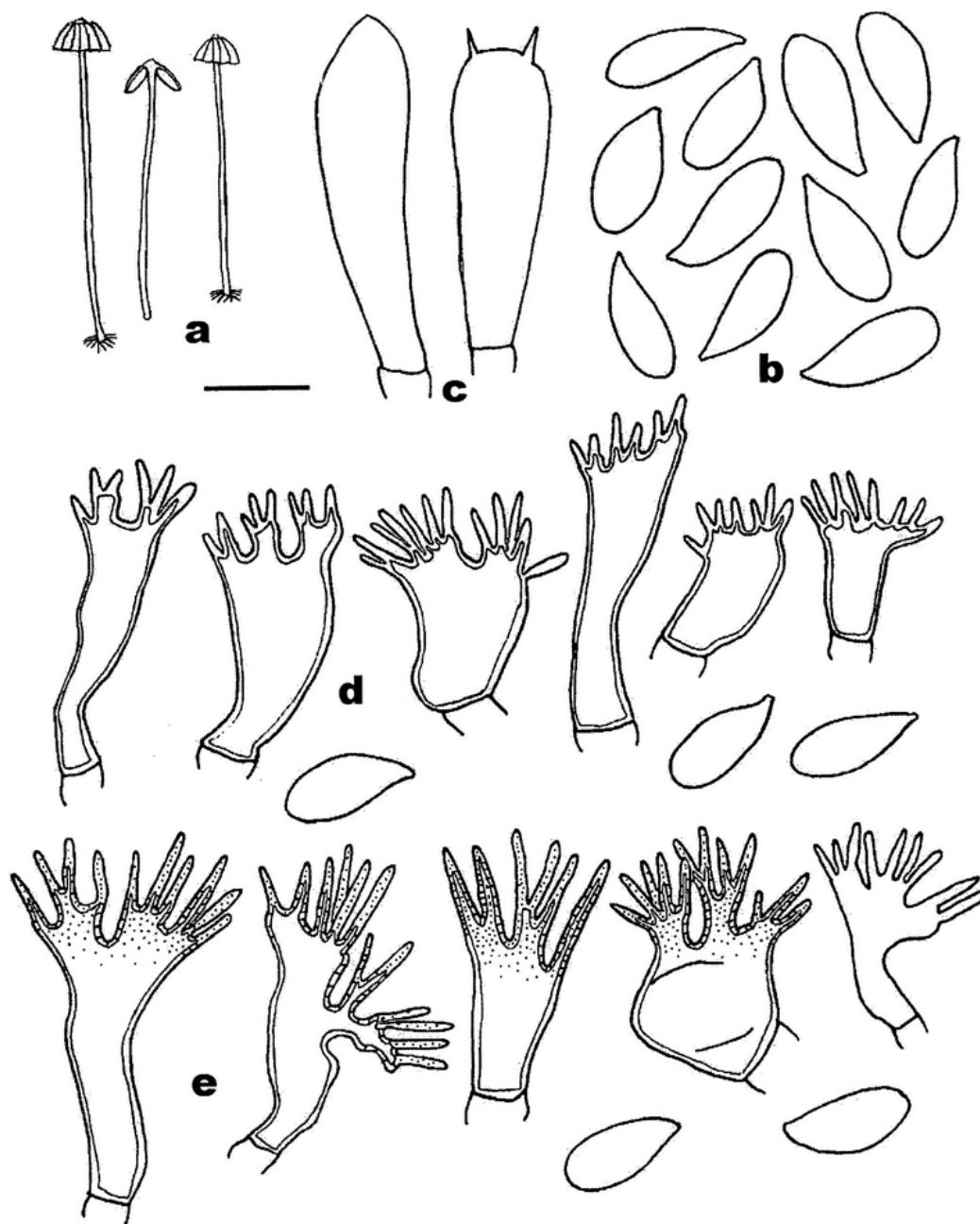
*Pileus* 5-8 mm latus, campanulatus vel convexus, papillatus, sulcatus vel plicatus, pruinosis, olivaceo-brunneus vel olivaceus. Lamellae adnatae, subdistantes (12-16), haud intervenosae, pallide stramineae, olivaceo-marginatae. Stipes 35-56 × 0.5 mm, cylindricus, glabrus, haud insititius, apicaliter

stramineus, basim atrobrunneus, ad basim tomento aurantio-brunneo strigosoque affixus. Basidiosporae 11-14 × 4-5.5 µm, ellipsoideae vel clavatae, leves, hyalinae, inamyloideae. Basidia 30-38 × 6-8 µm, clavatae, 4-spora. Cheilocystidia typi Sicci, 15-23 × 5-8 µm, cylindracea vel clavata, straminea; setulae ad apicem 4-7 × 0.5-1 µm, densae, cylindricae vel conicae, obtusae vel subacutae, stramineae, inamyloideae, tenuitunicatae. Pleurocystidia nulla. Pileipellis hymeniformis, typi Sicci, cellulae 10-26 × 5-9 µm, cylindricae, clavatae vel irregulare, stramineae, inamyloideae, crasse-tunicatae; setulae ad apicem 5-9 × 0.5-1 µm, cylindricae vel conicae, subacutae, pallide flavae vel flavo-brunneae, inamyloideae, tenui- vel crasse-tunicatae. Caulocystidia nulla. Fibulae presentes. Gregarius, ad folia putrida plantarum dicotyledonearum. Holotypus: Malaysia, Selangor, Selayang, Kanching Forest Reserve, 9 Jan 2005, Yee-Shin Tan, TYS 426 (Holotypus: KLU-M#90).

*Pileus* 5-18 mm diam, hemispherical to campanulate or broadly convex with an acute papilla; margin sulcate to plicate; surface dull, dry, pruinose; olive brown (4F8) with darker disc when young, in age becoming olive (2F7-8) overall. *Lamellae* adnate, subdistant (12-16) with 0-1 series of lamellulae, not intervenose, light yellow (4A2-3) with olive brown edge. *Stipe* 35-56 × 0.5 mm, central, terete, cylindrical, equal, dry, dull, glabrous, non-insititious, yellowish white (4A2) at the apex, dark brown at the base, with strigose brownish orange (6C8) to light brown (6D7-8) mycelium. *Odor* not distinctive.

*Basidiospores* 11-14 (-15) × 4-5.5 (-6) µm [ $x_{mr} = 12.3-13.1 \times 4.6-5.3 \mu\text{m}$ ,  $x_{mm} = 12.7 \pm 0.6 \times 5 \pm 0.5 \mu\text{m}$ ,  $Q = 1.9-3.5$ ,  $Q_{mr} = 1.9-2.8$ ,  $Q_{mm} = 2.6 \pm 0.4$ ,  $n = 25$  spores per 2 specimens], ellipsoid to clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* 30-38 × 6-8 µm, clavate, 4-spored. *Basidioles* 30-40 × 6-9 µm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (12-) 15-23 (-27) × (4-) 5-8 (-10) µm, cylindrical to clavate or broadly clavate, rarely lobed, light yellow, inamyloid, thin- to thick-walled; apical setulae (3-) 4-7 × 0.5-1 (-1.5) µm, crowded, narrowly cylindrical to conical, obtuse to subacute, rarely forked, yellow, inamyloid, thin-walled. *Pleurocystidia* absent. *Pileipellis* strongly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (8-) 10-26 (-33) × (4-) 5-9 (-12) µm, cylindrical to clavate, broadly clavate or irregular in outline, often lobed, light yellow,





**Fig. 33.** *Marasmius olivascens* (Holotype: TYS 426 = KLU-M#90). a. Basidiomes. b. Basidiospores. c. Basidia and basidiole. d. Cheilocystidia. e. Pileipellis. Bars: a = 20 mm, b-e = 10  $\mu$ m.

inamyloid, thick-walled; apical setulae 5-9 (-10)  $\times$  0.5-1  $\mu$ m, cylindrical to conical, rarely forked, subacute, light yellow to brownish yellow or golden brown, inamyloid to weakly dextrinoid, thin- to thick-walled. *Pileus trama* interwoven; hyphae 5-9  $\mu$ m diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 4-10  $\mu$ m diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 3-5  $\mu$ m diam, parallel, cylindrical, smooth, yellowish brown (apex) to brown (base), inamyloid to weakly dextrinoid, thick-walled, non-gelatinous;

medullary hyphae 6-9  $\mu$ m, parallel, cylindrical, smooth, hyaline, strongly dextrinoid, thick-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves and twigs. Malaysia (Selangor).

*Material examined:* Malaysia, Selangor, Selayang, Kanching Forest Reserve, 9 Jan. 2005, Yee-Shin Tan, TYS 426 (**Holotype:** KLU-M#90; **Isotype:** SFSU); same location, 9 Jan. 2005, Dennis Desjardin, TYS 424 (KLU-M#91, SFSU).

*Notes:* Diagnostic features of *M. olivascens* include: a plicate pileus 5-18 mm diam that is coloured olive overall; distant (12-

16) lamellae with 0-1 series of lamellulae that have olive edges; basidiospores 11-15 x 4-6  $\mu\text{m}$  with mean 12.7 x 5  $\mu\text{m}$ ; *Siccus*-type cheilocystidia with narrowly conical, acute setulae 3-7  $\mu\text{m}$  long; *Siccus*-type pileipellis broom cells with narrowly conical, acute setulae 5-9  $\mu\text{m}$  long; no pleurocystidia and no caulocystidia; and growth on dicotyledonous leaves. The new species is closest to *M. trinitatis* Dennis from the New World tropics and Papua New Guinea. The latter species differs in forming close lamellae with 2-3 series of lamellulae, smaller basidiospores in the range 8.5-12.5 x 3-4  $\mu\text{m}$  with mean about 10.5 x 3.3  $\mu\text{m}$ , and grows mainly on woody debris (Singer, 1976; Desjardin and Horak, 1997).

29. *Marasmius florideus* Berk. & Broome, J. Linn. Soc. Bot. 14: 39. 1873.

(Fig. 34, Plate 3F)

Type: Sri Lanka, Kandy District, Peradeniya, on dead wood, Sept 1897, Thwaites 204 p.p. (K).

*Pileus* 3-6 mm diam, convex to broadly convex, umbonate; margin smooth to striate; surface dull, dry, velutinous; reddish brown (8D7-8, 8E7-8) to brown (7E7-8). *Lamellae* adnate, close to subdistant (10-12) with 2-3 series lamellulae, not intervenose, pale yellow (4A3) with brown (7E8) edges. *Stipe* 16-33 x 0.5-1 mm, central, terete, equal, tough, dry, dull, glabrous, non-insititious, orangish white at the apex, gradually becoming orange, to grayish orange (6B5-6), golden yellow (5B7-8) or brown (6E8) at the base, with strigose grayish orange basal mycelium. *Odor* not distinctive.

*Basidiospores* (8-) 9.6-12 (-13) x 3-4  $\mu\text{m}$  [ $x = 10.4 \pm 2.2 \times 3.5 \pm 0.4 \mu\text{m}$ ,  $Q = 2-3.6$ ,  $Q_m = 3 \pm 0.4$ ,  $n = 22$  spores], narrowly ellipsoid to fusoid, clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* 17.6-19.2 x 4-4.8  $\mu\text{m}$ , fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (4.8-) 7.3-11.5 (-12.8) x 4.8-6.4 (-8)  $\mu\text{m}$ , cylindrical to clavate, broadly clavate or irregular in outline, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae (2-) 3.2-7 (-10) x 1-1.5  $\mu\text{m}$ , narrowly cylindrical to conical, rarely forked, yellow, inamyloid, thick-walled. *Pleurocystidia* absent.

*Pileipellis* weakly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 6.4-12.8 x 4.2-6.4  $\mu\text{m}$ , cylindrical to clavate, broadly clavate or irregular in outline, rarely lobed, hyaline to pale yellow, inamyloid, thick-walled; apical setulae (2-) 5-7 x 1  $\mu\text{m}$ , narrowly cylindrical to conical, rarely forked, subacute, yellow to yellowish brown, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae 5.4-6.4  $\mu\text{m}$  diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 5.1-6.4  $\mu\text{m}$  diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 3.2-4.8  $\mu\text{m}$  diam, parallel, cylindrical, smooth, light yellow to yellow, weakly dextrinoid to dextrinoid, thick-walled, non-gelatinous; medullary hyphae 4-5.4  $\mu\text{m}$  diam, parallel, cylindrical, smooth, hyaline, inamyloid to weakly dextrinoid, thick-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Malaysia (Selangor), Sri Lanka.

*Material examined:* Malaysia, Selangor, Pangsun, Mount Nuang Forest Reserve, N 03° 12.593', E 101° 52.575', 319 m, 17 May 2005, Yee-Shin Tan, TYS 480 (SFSU).

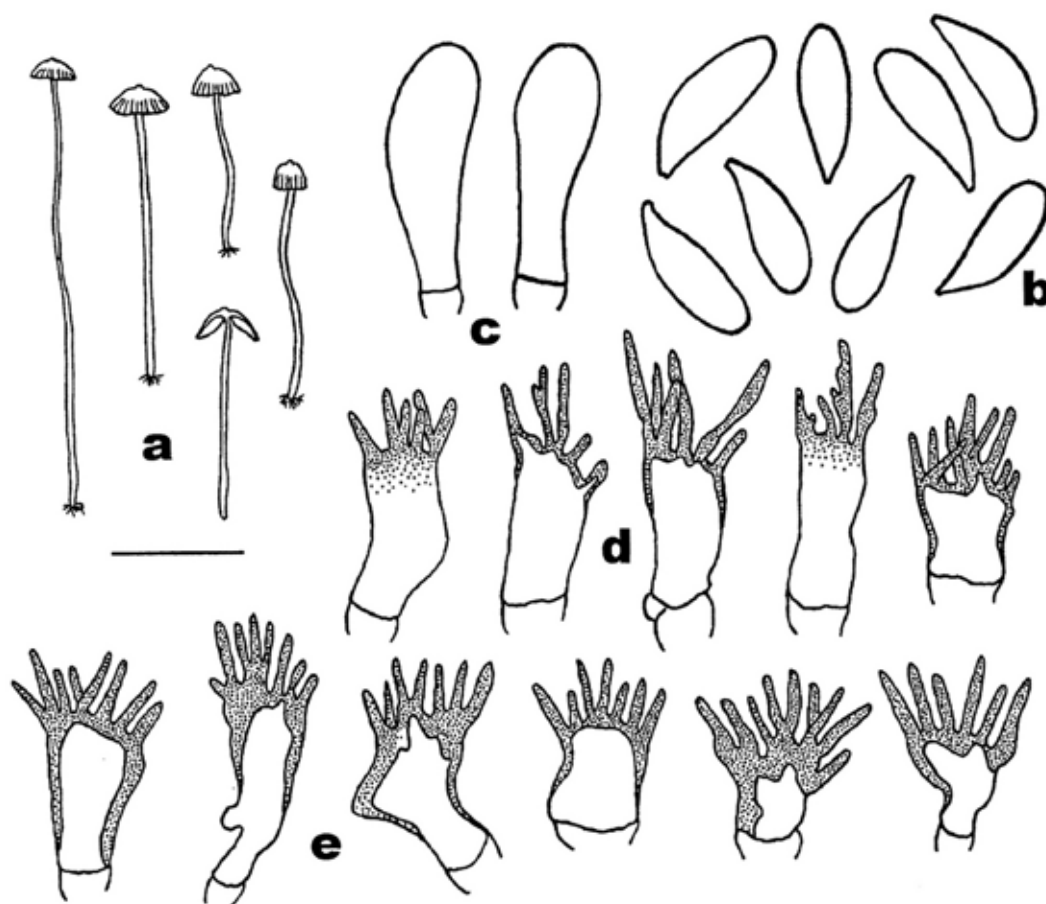
*Notes:* *Marasmius florideus* Berk. & Broome, described from Sri Lanka, is characterized by a smooth to striate, conical-subumbonate, dark reddish brown pileus; subdistant (10-12) lamellae with reddish brown edges; a glabrous stipe lacking caulocystidia; basidiospores in the range 8-12 x 3-4.5  $\mu\text{m}$  (mean 10.4 x 3.5  $\mu\text{m}$ ); no pleurocystidia; and cheilocystidia and pileipellis broom cells with narrowly conical, acute setulae 3-10  $\mu\text{m}$  long.

30. *Marasmius acerosus* Y.S. Tan & Desjardin, Fungal Diversity 25: 192. 2007.

(Fig. 35, Plate 3B)

Type: Malaysia, Selangor, Sungai Chongkak Forest Reserve, 16 May 2005, Y.S. Tan #458 (KLU-M #2!).

*Pileus* 4-15 mm diam, conical to convex with a small umbo when young, becoming broadly convex to plano-convex in age; margin smooth to weakly striatulate in age; surface dry, dull, glabrous; grayish yellow (4B4) with

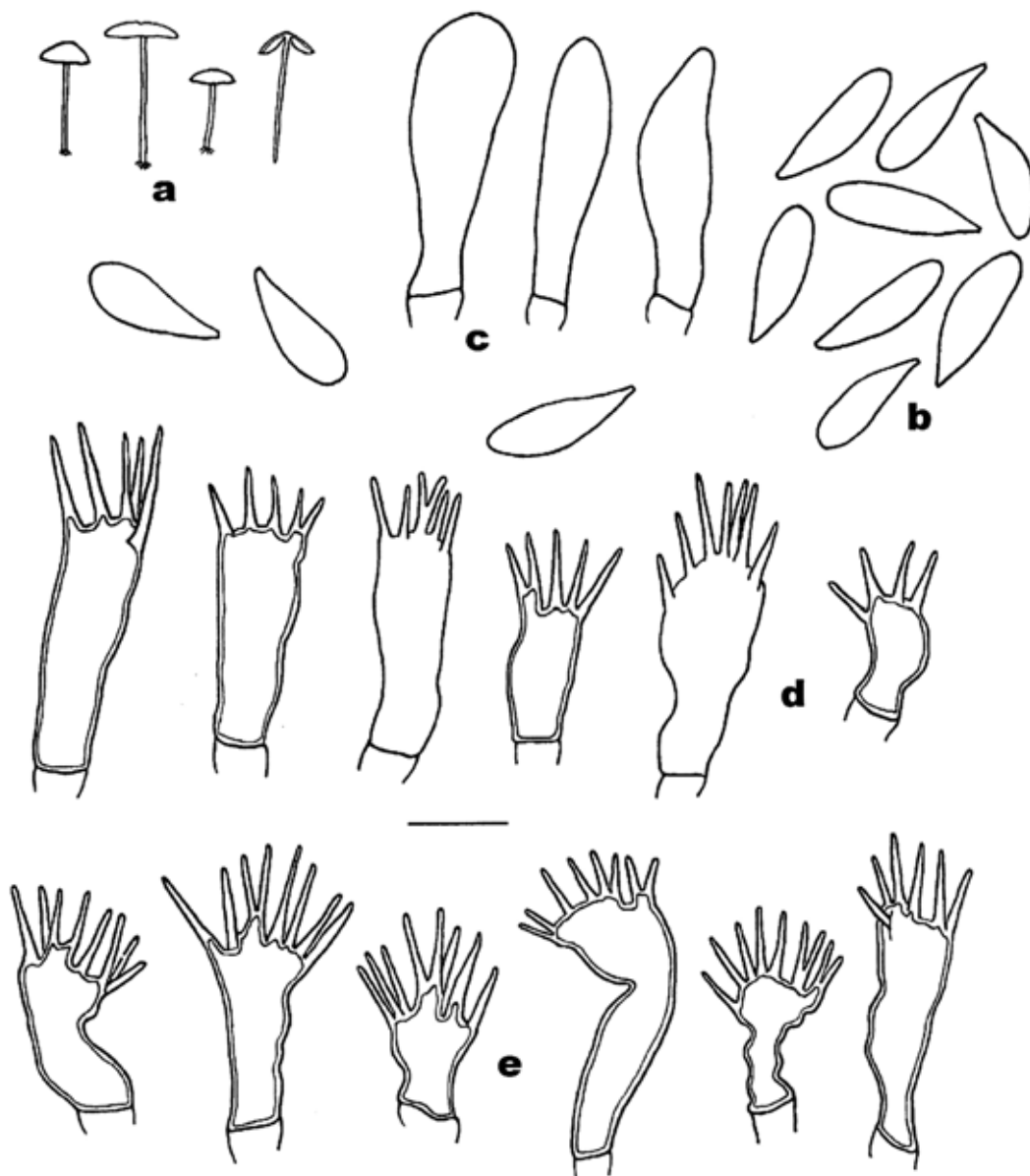


**Fig. 34.** *Marasmius florideus* (TYS 480). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

brownish orange (5C6) disc when young, in age becoming grayish yellow (5B5) to golden brown with a brown (6E7) disc, or grayish yellow (4B6) with a brownish orange (5B5) disc. *Lamellae* adnate, crowded (16-25) with 3-4 series of lamellulae, light yellow (3A4), non-marginate. *Stipe* 15-34  $\times$  0.5 mm, central, terete, equal, dry, dull, glabrous, non-insititious, yellowish white (4A2) at the apex, gradually grading to brownish orange (5C6) or light brown (6D7-8) at the base, with strigose pale orange (5A3) basal mycelium. Odor pleasant.

*Basidiospores* 13-15 (-15.5)  $\times$  4-4.5 (-5)  $\mu$ m [ $x_{mr}$  = 14.3-14.4  $\times$  4.4-4.7  $\mu$ m,  $x_{mm}$  = 14.4  $\pm$  0.1  $\times$  4.5  $\pm$  0.2  $\mu$ m, Q = 2.9-3.8,  $Q_{mr}$  = 3.1-3.3,  $Q_{mm}$  = 3.2  $\pm$  0.2, n = 18 spores per 2 specimens], elongate-lacrymoid to clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* 23-36  $\times$  6-8  $\mu$ m, fusoid to clavate. Lamellar edge sterile, with a broad band of cheilocystidia; *cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (8-)12-24  $\times$  6-10  $\mu$ m, cylindrical to clavate, broadly clavate or

irregular in outline, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae 2-10  $\times$  0.5-1  $\mu$ m, crowded, conical to acerose, subacute to acute, rarely forked, light yellow, inamyloid, thick-walled. *Pleurocystidia* absent. *Pileipellis* weakly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (8-) 10-25  $\times$  6-13  $\mu$ m, cylindrical to clavate, broadly clavate or irregular in outline, rarely lobed, light yellow, inamyloid, thick-walled; apical setulae 6-13  $\times$  0.5-1  $\mu$ m, conical to acerose, rarely forked, acute, yellow to yellowish brown, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae 4-9  $\mu$ m diam, cylindrical, hyaline, weakly dextrinoid to dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 3.5-5  $\mu$ m diam, cylindrical, hyaline, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4.5-6  $\mu$ m diam, parallel, cylindrical, smooth, yellow (apex) to brownish yellow (base), inamyloid to weakly dextrinoid, thick-walled (-1  $\mu$ m), non-gelatinous; medullary hyphae 5-9  $\mu$ m diam,



**Fig. 35.** *Marasmius acerosus* (Holotype: TYS 458 = KLU-M#2). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

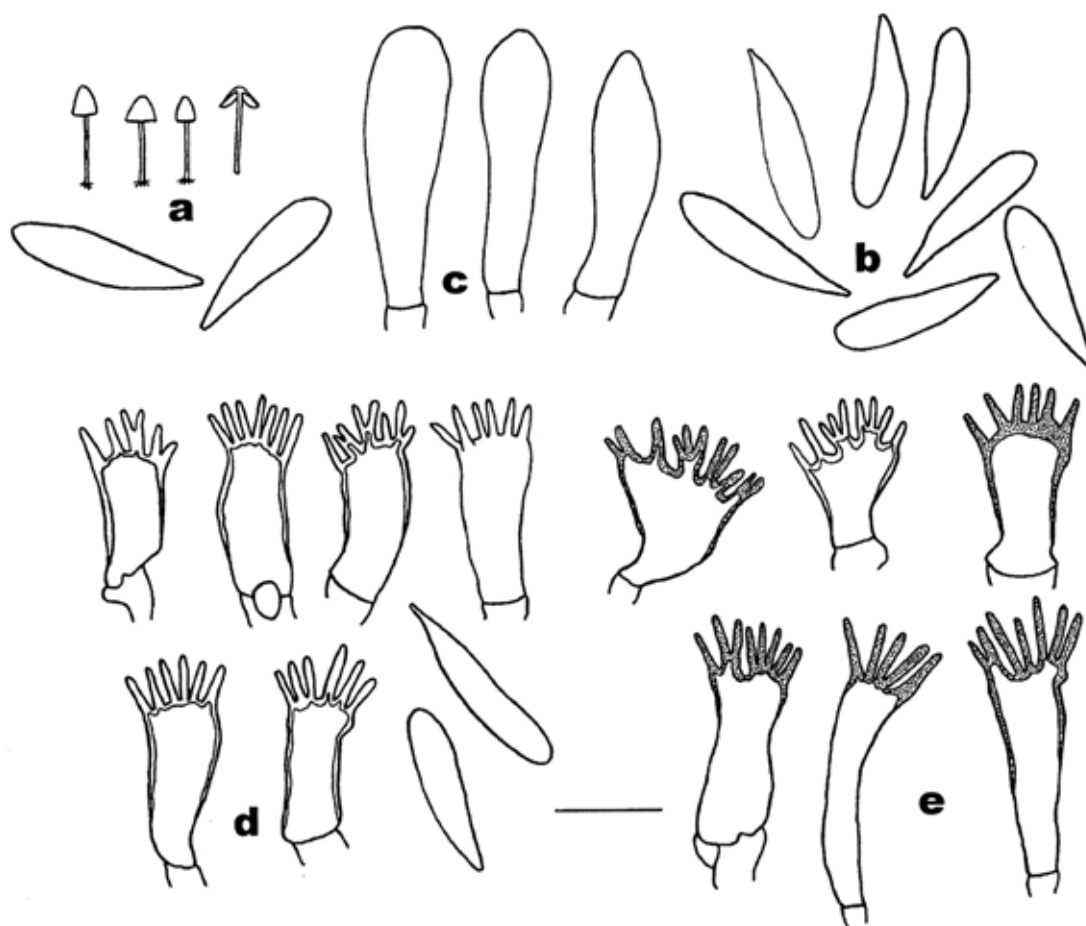
parallel, cylindrical, smooth, hyaline to light yellow, dextrinoid, thin-walled. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves and twigs. Malaysia (Selangor).

*Material examined:* Malaysia, Selangor, Kanching Forest Reserve, N 03°171.958', E 101° 37.15', 110 m elev., 9 Jan 2005, Yee-Shin Tan, TYS 427 (KLU-M#29, SFSU); Selangor, Sungai Chongkak Forest Reserve, 16 May 2005, Yee-Shin Tan, TYS 458 (**Holotype:** KLU-M #2; **Isotype:** SFSU).

*Notes:* *Marasmius acerosus* is characterized by the following features: a smooth to weakly striatulate pileus coloured brownish orange on the disc and grayish yellow on the margin; crowded lamellae (16-

25 with 3-4 series of lamellulae) with non-marginate edges; basidiospores in the range 13-15  $\times$  4-4.5  $\mu$ m with mean 14.4  $\times$  4.5  $\mu$ m; *Siccus*-type cheilocystidia and pileipellis broom cells with needle-like setulae up to 10  $\mu$ m long or longer; and growth on dicotyledonous leaves. The new species is similar to *M. abundans* Corner and its varieties from Malaysia, and to *M. berteroi* (Lév.) Murrill from Java and the neotropics. *Marasmius abundans* differs in forming fewer lamellae (ca 14-19), slightly longer basidiospores (mean length 15.4-16.2  $\mu$ m), and cheilocystidia with cylindrical to subconical, obtuse setulae only up to 7  $\mu$ m long (Corner, 1996; type studies and this paper). *Marasmius*



**Fig. 36** *Marasmius bambusiniiformis* (TYS 511). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

*berteroi* differs in forming plicate pilei, subdistant lamellae (11-16), and cheilocystidia with obtuse to subacute setulae up to 5  $\mu$ m long (Desjardin *et al.*, 2000).

A bipolar (unifactorial) mating system was reported for *M. acerosus* by Tan *et al.* (2007).

31. *Marasmius bambusiniiformis* Singer, Fl. Neotrop. Monogr. 17: 167. 1976. (Fig. 36)

Type: Ecuador, Napo, Lago Agrio, 16 May 1973, Singer B7480 (F!).

*Pileus* 1.5-5 mm diam, convex to obtusely conical; margin smooth when young, striate to sulcate in age; surface dull, dry, subvelutinous; orange (6A7, 6B7-8) to reddish orange (7B8). *Lamellae* adnate, subdistant (12-13) with 0-1 series of lamellulae, not intervenose, yellowish white, non-marginate. *Stipe* 10-30  $\times$  0.5-1 mm, central, terete, equal, tough, dry, dull, glabrous, non-insititious, yellowish white at the apex, grading to brownish orange or reddish brown (6E8) at the

base, with strigose grayish orange basal mycelium. *Odor* not distinctive.

*Basidiospores* (15-) 16-18 (-19)  $\times$  3-3.5 (-4)  $\mu$ m [ $x = 16.9 \pm 1.3 \times 3.4 \pm 0.5 \mu$ m,  $Q = 3.8-6.3$ ,  $Q_m = 5 \pm 0.6$ ,  $n = 27$  spores], narrowly ellipsoid to fusoid or clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* 22-26  $\times$  6-7  $\mu$ m, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body 13-16  $\times$  5-7  $\mu$ m, cylindrical to clavate, broadly clavate or irregular in outline, rarely lobed, light yellow, inamyloid, thick-walled; apical setulae 3-5.5  $\times$  0.5-1  $\mu$ m, narrowly cylindrical to conical, rarely forked, light yellow, inamyloid, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 10-20  $\times$  3-8 (-10)  $\mu$ m, cylindrical to clavate, broadly clavate or irregular in outline, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae 4-6 (-7)  $\times$  0.5-1  $\mu$ m, narrowly cylindrical to conical, rarely forked, subacute, hyaline to

brownish yellow or dull yellow, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae 4-5  $\mu\text{m}$ , cylindrical, hyaline, weakly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 3-5  $\mu\text{m}$  diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 3-5  $\mu\text{m}$  diam, parallel, cylindrical, smooth, brownish yellow, inamyloid, thick-walled, non-gelatinous; medullary hyphae 4-7  $\mu\text{m}$  diam, parallel, cylindrical, smooth, hyaline, weakly dextrinoid, thick-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* solitary and gregarious on undetermined dicotyledonous leaves. South America (Brazil, Ecuador), Malaysia (Johore), Papua New Guinea, United States (Florida).

*Material examined:* Malaysia, Johore, Endau Rompin National Park, way to NERC, Peta village, Temiang trail, 14 July 2005, Yee-Shin Tan, TYS 511 (SFSU).

*Notes:* *Marasmius bambusiniformis* has diagnostic features that include a small, obtusely conical to convex, smooth to striate, orange to reddish orange pileus, subdistant, narrow lamellae, a glabrous stipe lacking caulocystidia, moderately long basidiospores (16-18  $\times$  3.3-5  $\mu\text{m}$  with mean 16.9  $\times$  3.4  $\mu\text{m}$ ), and growth on dicotyledonous leaves. The Malaysian material matches nicely specimens reported from Papua New Guinea (Desjardin and Horak, 1997), and differs subtly from South American material in having more lamellae (12-13 versus 7-10 in the holotype @ F!).

**32. *Marasmius abundans* Corner var. *abundans***, Beih. Nova Hedwigia 111: 22. 1996.  
(Fig. 37 & 38, Plate 3G)

Type: Singapore, Gardens Jungle, 15 Oct. 1929, Corner s.n. (E #205879).

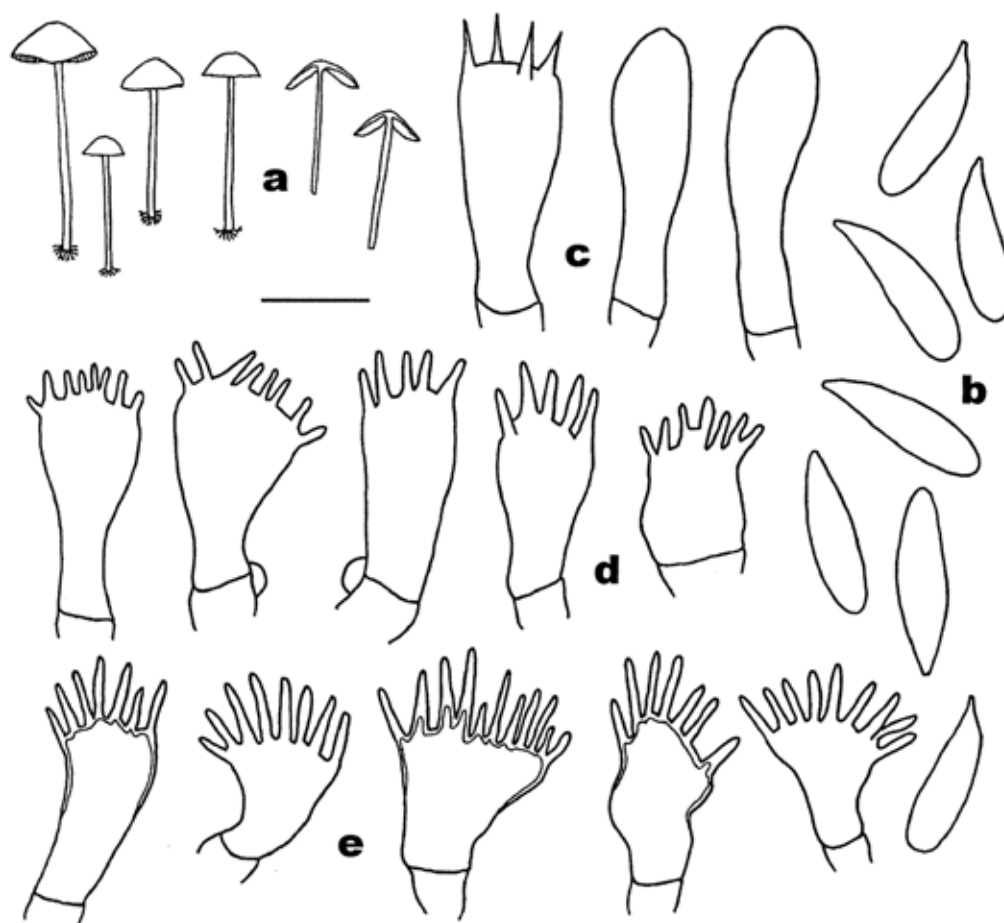
*Pileus* 8-17 mm diam, obtusely conical to convex or broadly convex; margin smooth (non-striate); surface dry, dull, hygrophanous, minutely velutinous; grayish orange (5B6) to golden yellow (5B7), orange (5A7), light orange (5A5), brownish yellow (5C7-8) or ferruginous. *Lamellae* adnate, close (14-17) with 4-5 series of lamellulae, yellowish white, non-marginate. *Stipe* 32-45  $\times$  0.5-1 mm, central,

cylindrical, terete, equal, dry, dull, glabrous, non-insititious, yellowish white at the apex, gradually changing to orange, deep orange, yellowish brown (5E8) or brownish red (8C7-8) at the base, with brownish orange basal mycelium.

*Basidiospores* 12-18 (-20)  $\times$  4-5  $\mu\text{m}$  [ $x_{\text{mr}} = 15.8-16.6 \times 4.1-4.6 \mu\text{m}$ ,  $x_{\text{mm}} = 16.2 \pm 0.6 \times 4.4 \pm 0.4 \mu\text{m}$ ,  $Q = 3.8-4.5$ ,  $Q_{\text{mr}} = 3.4-4.1$ ,  $Q_{\text{mm}} = 3.8 \pm 0.5$ ,  $n = 17$  spores per 9 specimens], elongate-lacrymoid to clavate, smooth, hyaline, inamyloid. *Basidia* 24-28  $\times$  6-10  $\mu\text{m}$ , 4-spored. *Basidioles* 26-28 (-32)  $\times$  6-7  $\mu\text{m}$ , fusoid to clavate. *Cheilocystidia* numerous, lamellar edge sterile, composed of *Siccus*-type broom cells; main body (10-) 11-20 (-22)  $\times$  6-10 (-11)  $\mu\text{m}$ , cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin-walled; apical setulae (2-) 2.5-4 (-5)  $\times$  0.5-1  $\mu\text{m}$ , crowded, cylindrical to conical, subacute to obtuse, light yellow to yellow, inamyloid, thick-walled. *Pleurocystidia* absent. *Pileipellis* weakly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (7-) 10-13 (-16)  $\times$  (5-) 6-11 (-12)  $\mu\text{m}$ , cylindrical to clavate or subglobose, hyaline, inamyloid, thick-walled; apical setulae 3-7 (-8)  $\times$  0.5-1  $\mu\text{m}$ , cylindrical to conical, yellow, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae 5-10  $\mu\text{m}$  diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 3.5-6  $\mu\text{m}$  diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-5  $\mu\text{m}$  diam, parallel, cylindrical, smooth, light yellow (apex) to yellow (base), weakly dextrinoid, thick-walled, non-gelatinous; medullary hyphae 3-8  $\mu\text{m}$  diam, parallel, cylindrical, smooth, hyaline, dextrinoid, thick-walled. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Malaysia (Selangor), Singapore.

*Material examined:* Malaysia, Johore, Endau Rompin National Park, NERC, Peta Village, on way to jetty, 14 July 2005, Yee-Shin Tan, TYS 513 (KLU-M#28, SFSU); Kedah, Langkawi Island, Matchinchang Forest Reserve, 1 Sept. 2004, Yee-Shin Tan, TYS 344 (KLU-M#79, SFSU); Selangor, Sungai Chongkak Forest Reserve, N 03°12.705', E 101°50.472', elev. 122 m, 16 May 2005, Yee-Shin Tan, TYS 460



**Fig. 37** *Marasmius abundans* var. *abundans* (TYS 460 = KLU-M#27). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 20 mm, b-e = 10 µm.

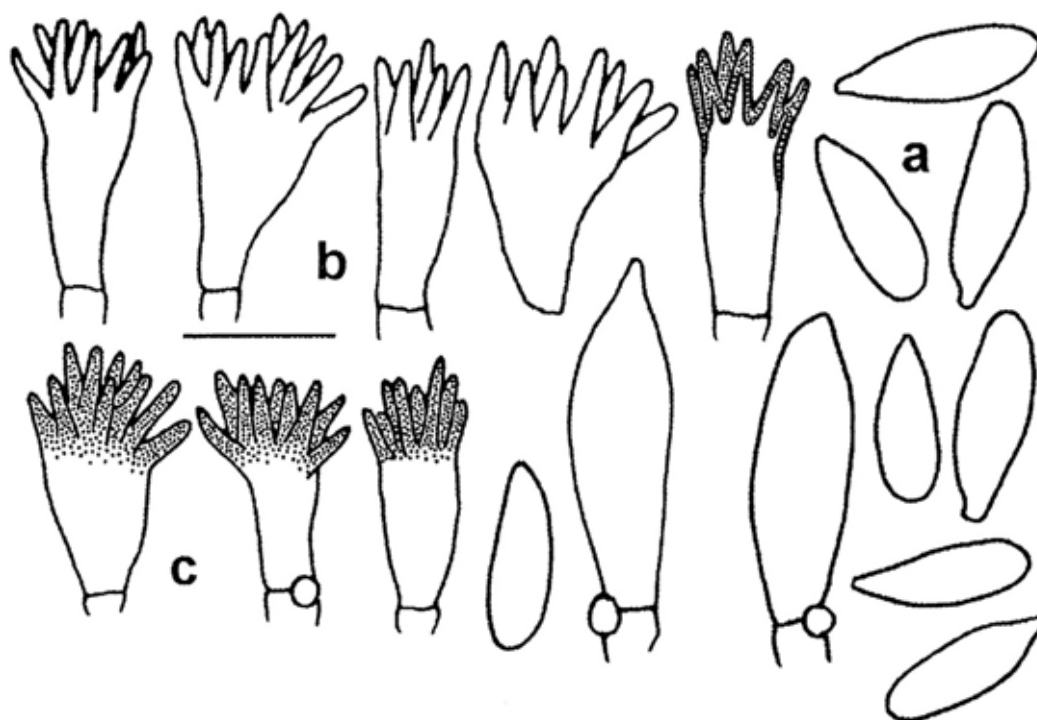
(KLU-M#27, SFSU), same location, 1 Jan. 2006, Yee-Shin Tan, TYS 530 (KLU-M#81, SFSU); Selangor, Selayang, Kanching Forest Reserve, N 03°17.958', E 101°37.151', elev. 110 m, 9 Jan 2005, Yee-Shin Tan, TYS 425 (KLU-M#24, SFSU); Singapore, Gardens Jungle, 15 Oct. 1929, Corner s.n. (**Holotype**: E #205879).

**Notes:** *Marasmius abundans* var. *abundans* has only been reported from Malesia (Corner, 1996). This species is distinguished by a moderately large, grayish orange to light orange, smooth pileus, close (14-17) lamellae, a glabrous stipe, and relatively large basidiospores (12-18 × 4-4.5 µm). It has been reported as very common on the Malay Peninsula, hence the choice of epithets (Corner, 1996). The difference between *M. abundans* var. *abundans* and *M. abundans* var. *aurantiacus* is indicated in the key.

#### **Type Study of *Marasmius abundans* var. *abundans*:**

The holotype specimen (Singapore, Gardens Jungle, 15 Oct. 1929, Corner s.n., E

#205879) is a mixture of two species, comprising approx. 8 basidiomes, whole or fragmented, in fair condition, attached to dicot leaves: Species 1, herein recognized as the holotype specimen. As dried: *Pileus* 5-7 mm diam, convex, margin even and not striate or very short-striatulate, ferruginous to reddish brown. *Lamellae* adnexed, close, narrow. *Stipe* 25-30 × 1 mm, terete, cylindrical, glabrous, non-insititious, with rusty basal mycelium. *Basidiospores* 11-14 × 3.8-4.5 µm, subfusoid to clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* subfusoid, sometimes mucronate. *Cheilocystidia* abundant, edge sterile, composed of *Siccus*-type broom cells; main body 12-16 × 5-10 µm, subcylindrical to clavate, rarely lobed, hyaline, thin-walled; apical setulae 3.2-6.5 × 1-1.5 µm, conical, acute, thin- to thick-walled, hyaline to pale yellow, inamyloid. *Pleurocystidia* absent. *Pileipellis* not mottled, a hymeniform layer of *Siccus*-type broom cells; main body 9.5-15 × 5-8 µm, subcylindrical to



**Fig. 38.** *Marasmius abundans* var. *abundans* (Holotype: E#205879). a. Basidiospores. b. Cheilocystidia. c. Pileipellis. Bar = 10  $\mu$ m.

clavate, basally hyaline and thin-walled, apically yellowish brown and thick-walled; apical setulae  $3-6.5 \times 1-1.5 \mu\text{m}$ , conical, acute, thin-walled to thick-walled, yellowish brown, weakly dextrinoid. *Stipe tissue* monomitic; cortical hyphae parallel, cylindrical, smooth, pale tawny, dextrinoid, thin-walled; medullary hyphae similar but hyaline. *Caulocystidia* absent. *Clamp connections* present.

Species 2: similar to species one except that the pileus is striate-sulcate to the disc, and the lamellae are distant and broad. This portion of the holotype specimen will not be considered here.

33. *Marasmius abundans* var. *aurantiacus* Corner, Beih. Nova Hedwigia 111: 23. 1996.

(Fig. 39, Plate 3K)

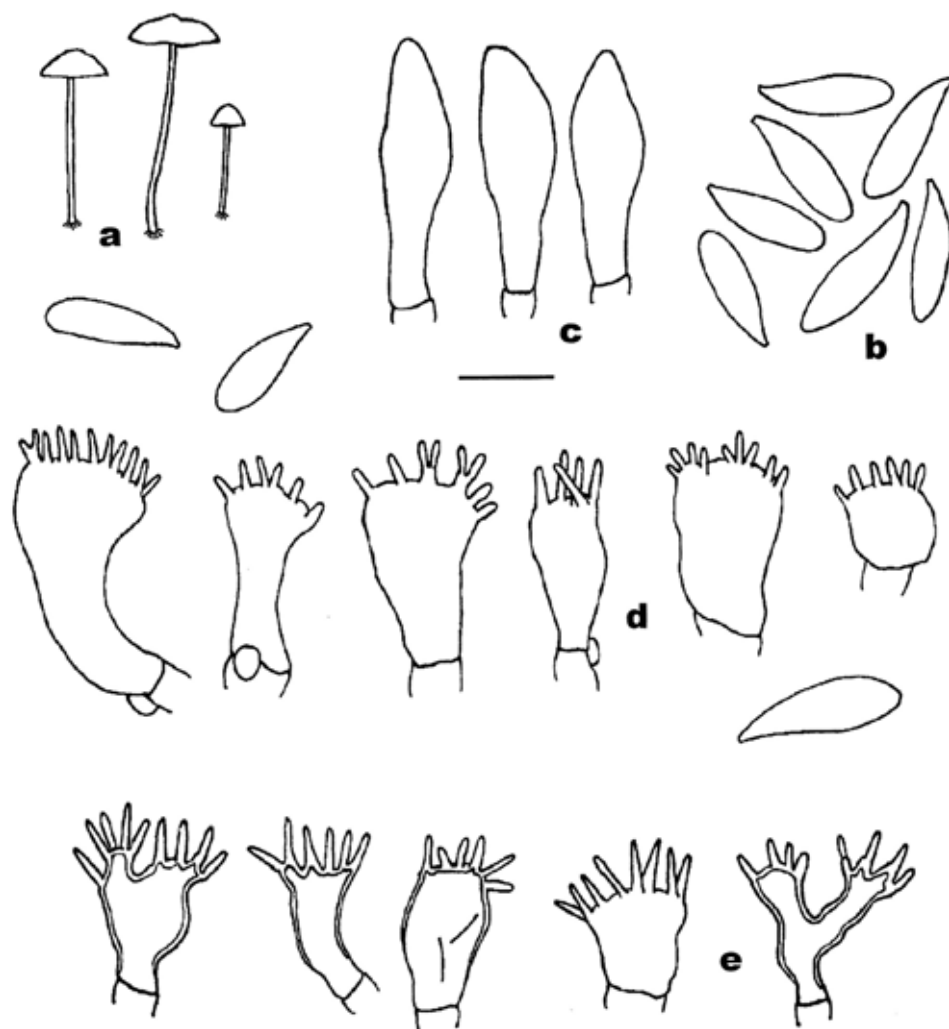
Type: Singapore, Botanic Garden, Corner s.n., 15 Dec. 1941 (E).

*Pileus* 3-30 mm diam, paraboloid to broadly obtusely conical or broadly convex; margin smooth (non-striate); surface dry, dull, hygrophanous, minutely velutinous; orange (5A6, 6B7-8) to grayish orange (5B5-6, 6B4-6) or golden yellow (5B7) with deep orange around the disc when young, becoming deep orange (5B8, 6A8) overall at maturity. *Lamellae* adnate, close (14-19) with 3-5 series

of lamellulae, orangish white, non-marginate. *Stipe* 11-67  $\times$  0.5-1 mm, central, cylindrical, terete, equal, dry, dull, glabrous, non-insititious, yellowish white at the apex, gradually changing to orange, grayish orange, brownish orange, light brown or reddish brown on the base, with brownish orange basal mycelium.

*Basidiospores* (11-) 13-17 (-20)  $\times$  (3-) 4-5 (-6)  $\mu\text{m}$  [ $x_{\text{mr}} = 14.3-16.6 \times 4.1-4.7 \mu\text{m}$ ,  $x_{\text{mm}} = 15.4 \pm 0.9 \times 4.4 \pm 0.3 \mu\text{m}$ ,  $Q = 2.9-4.5$ ,  $Q_{\text{mr}} = 3.3-4.1$ ,  $Q_{\text{mm}} = 3.5 \pm 0.3$ ,  $n = 25$  spores per 4 collections], elongate-lacrymoid to clavate, smooth, hyaline, inamyloid. *Basidia* 20-26  $\times$  5-10  $\mu\text{m}$ , 2-spored and 4-spored. *Basidioles* 23-28 (-32)  $\times$  6-8  $\mu\text{m}$ , fusoid to clavate. *Cheilocystidia* numerous, lamellar edge sterile, composed of *Siccus*-type broom cells; main body (8-) 13-20 (-23)  $\times$  5-12  $\mu\text{m}$ , cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin-walled; apical setulae 2-5 (-7)  $\times$  0.5-1  $\mu\text{m}$ , crowded, cylindrical to conical, subacute to obtuse, light yellow, inamyloid, thick-walled. *Pleurocystidia* absent. *Pileipellis* weakly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (5-) 7-17 (-22)  $\times$  (4-) 5-13  $\mu\text{m}$ , cylindrical to clavate or subglobose, hyaline, inamyloid, thick-walled; apical setulae 3-7 (-8)  $\times$  0.5-1  $\mu\text{m}$ , cylindrical





**Fig. 39.** *Marasmius abundans* var. *aurantiacus* (TYS 515 = KLU-M #1). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 20 mm, b-e = 10  $\mu$ m.

to conical, light yellow to tawny, weakly dextrinoid, thick-walled. *Pileus trama* interwoven; hyphae 4-7  $\mu$ m diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 3-6  $\mu$ m diam, cylindrical, hyaline, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-6  $\mu$ m diam, parallel, cylindrical, smooth, yellow (apex) to brownish yellow (base), weakly dextrinoid to dextrinoid, thick-walled; medullary hyphae parallel, cylindrical, smooth, hyaline, dextrinoid, thin-walled. *Caulocystidia* absent. *Clamp connections* present.

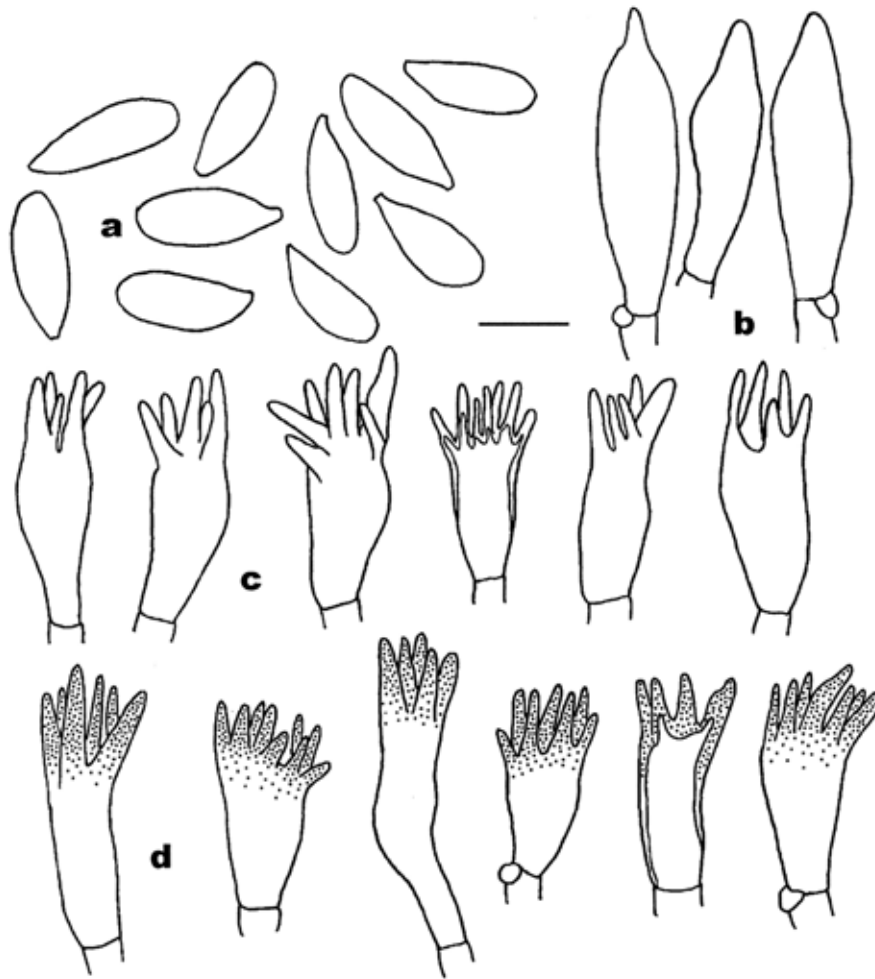
*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Malaysia (Johore, Selangor), Singapore.

*Material examined:* Malaysia, Johore, Endau Rompin National Park, NERC, Peta Village, on way to jetty, 14 July 2005, TYS 515 (KLU-M #1, SFSU);

Selangor, Sungai Chongkak Forest Reserve, N 03°12.705', E 101°50.472', elev. 122 m, 16 May 2005, Yee-Shin Tan, TYS 455 (KLU-M#25, SFSU); same location, 16 May 2005, Yee-Shin Tan, TYS 456 (KLU-M#26, SFSU); Selangor, Ulu Gombak, University of Malaya's Field Study Center, 28 July 2003, Yee-Shin Tan, TYS 035 (KLU-M#23, SFSU).

*Notes:* The specimen matches quite closely to Corner's protologue (1996), differing only in basidiospore size. The Malaysian specimens have basidiospores with means in the 14.3-16.6  $\times$  4.1-4.7  $\mu$ m, whereas the protologue documents smaller basidiospores in the range 11-13  $\times$  3.5-4  $\mu$ m. It is quite close to *M. fulviceps* Berk., described from Sri Lanka, but that species reputedly grows on wood and has spores 10-12.5  $\times$  4-5  $\mu$ m (Pegler, 1986).

A bipolar (unifactorial) mating system was reported for *M. abundans* var. *aurantiacus* by Tan *et al.* (2007) based on Malaysian material.



**Fig. 40.** *Marasmius abundans* var. *campanulatus* (Holotype: E#205853). a. Basidiospores. b. Basidioles. c. Cheilocystidia. d. Pileipellis. Bars: a-d = 7  $\mu$ m.

34. *Marasmius abundans* var. *campanulatus*  
Corner, Beih. Nova Hedwigia 111: 23. 1996.

(Fig. 40)

This variety of *M. abundans* was described by Corner from material collected in Singapore and has not yet been found in Malaysia although the species is expected to occur here.

**Type study of *Marasmius abundans* var. *campanulatus*:**

Type: Singapore, Botanic Gardens, 23 March 1943, Corner s.n. (E #205853); annotated as the type by Corner on the specimen deposited at E, and he noted that a painting of this specimen was made.

The holotype specimen consists of approx. 20 basidiomes, loose or attached to dicot leaves and twigs, most in good condition but a few infected by a mold. As dried: *Pileus*

3-7 mm diam, convex, sometimes with a small rounded umbo, margin even, not striate, glabrous, ferruginous to reddish brown. *Lamellae* adnexed, close to crowded (17-20) with 3-4 series of lamellulae, narrow, dark brown. *Stipe* 5-20  $\times$  1 mm, central, cylindrical, glabrous, non-insititious, arising from orangish-tawny basal mycelium, brown; no rhizomorphs.

*Basidiospores* 9.6-11.8  $\times$  3.5-4.2  $\mu$ m [ $x = 10.7 \times 3.9 \mu$ m], ellipsoid to subfusoid, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* subfusoid, often mucronate. *Cheilocystidia* abundant, edge sterile, composed of *Siccus*-type broom cells; main body 11-15  $\times$  4.5-6.5  $\mu$ m, clavate to broadly clavate, hyaline, thin-walled; apical setulae 2.5-6.5 (-10)  $\times$  1.3-2  $\mu$ m, conical, acute, hyaline, thin-walled. *Pleurocystidia* absent. *Pileipellis* not mottled, composed of a hymeniform layer of *Siccus*-type broom cells;

main body 10-18 × 3.5-8 µm, cylindrical to clavate, hyaline, thin-walled, inamyloid; apical setulae 2.5-8 × 1-1.5 µm, conical, acute, hyaline to pale yellowish brown, weakly dextrinoid, thin-walled to slightly thick-walled. *Stipe tissue* monomitic; cortical hyphae 3-6.5 (-8) µm diam, cylindrical, parallel, pale yellowish brown to brown, firm-walled, dextrinoid; medullary hyphae similar but hyaline. *Caulocystidia* absent. *Clamp connections* present.

*Notes:* There is confusion concerning which specimen represents the type of this variety. Corner annotated this specimen from the Singapore Botanic Gardens (23 March 1943) as type and he noted on the packet that a painting was made; but in the protologue he reported a specimen from Bukit Timah (23 July 1943) as the type, and did not note that a painting was made of this latter specimen. However, the minimal description and the painting (Plate 6b) seem to match better the Bukit Timah specimen than the Botanic Garden specimen that was annotated as the type. Unfortunately, these two specimens are not conspecific.

Specimen Bukit Timah, 23 July 1943. This specimen matches the protologue, including forming a striate pileus and broad, distant lamellae. The three basidiomes in the colour painting (Plate 6b) match the basidiomes in the specimen packet, although there is no note on the packet that a painting was made of this specimen. This specimen is not conspecific with the specimen from the Singapore Botanic Gardens that Corner annotated as type! In addition, this specimen does not appear to be conspecific with the type of *M. abundans* var. *abundans*. This specimen is very moldy and no pertinent microscopic features were retrieved.

35. *Marasmius persicinus* Desjardin, Retn. & E. Horak, Sydowia 52: 164. 2000.

(Fig. 41, Plate 3D)

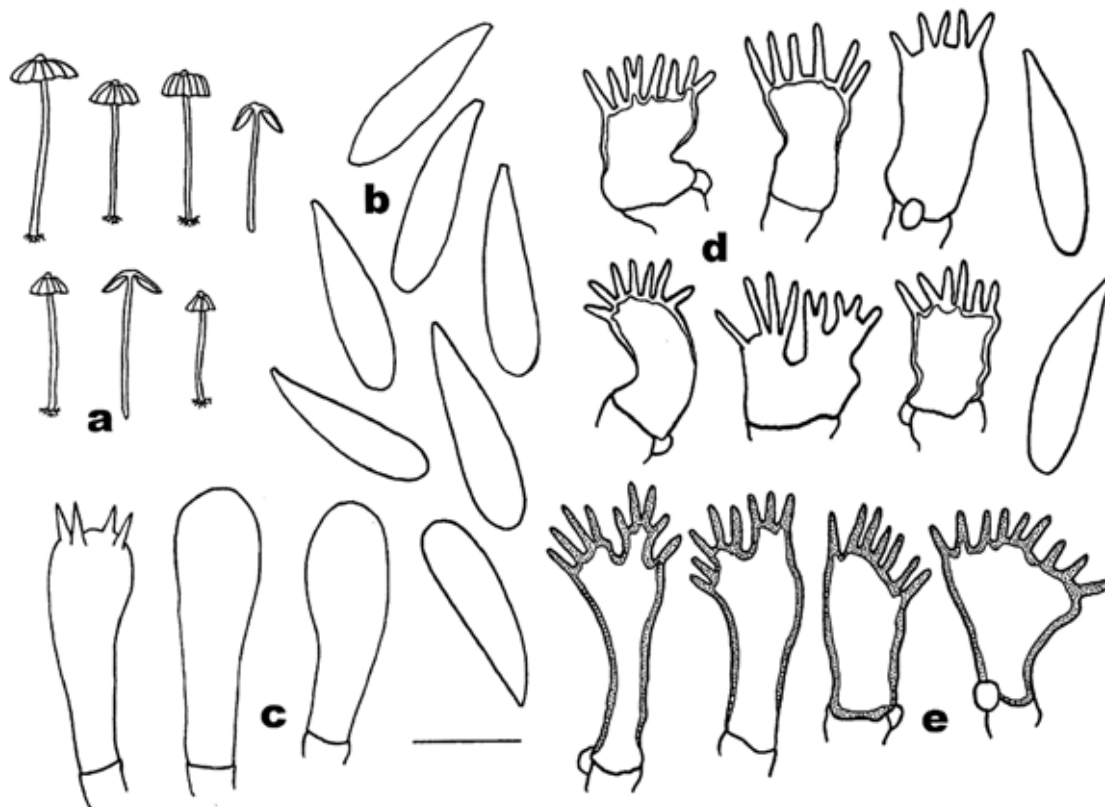
Type: Indonesia, Java, West Java, Mt. Halimun National Park, loop trail from Cikaniki, 14 Jan 1998, D.E. Desjardin 6793 (BO!).

*Pileus* 3-10 mm diam, paraboloid to obtusely conical, expanding in age to broadly

convex with an umbo; margin sulcate to plicate; surface dry, dull, minutely velutinous; orange (5A6-7, 6B7-8) with light orange (5A5) disc, seldom brownish orange (6C7-8). *Lamellae* adnate, subdistant to close (8-16) with no lamellulae, orangish white (11A2) with grayish orange edge. *Stipe* 10-30 × 0.2-0.5 mm, central, cylindrical, terete, equal, dry, dull, glabrous, non-insititious, orangish white at the apex grading to orange and dark brown at the base, with brownish orange basal mycelium.

*Basidiospores* (14-) 16-21 × 3.5-5 µm [ $x_{mr} = 17.8-18.3 \times 3.6-4 \mu\text{m}$ ,  $x_{mm} = 18.1 \pm 0.4 \times 3.8 \pm 0.3 \mu\text{m}$ ,  $Q = 3.1-6$ ,  $Q_{mr} = 4.6-5.1$ ,  $Q_{mm} = 4.9 \pm 0.3$ ,  $n = 38$  spores per 2 specimens], elongate-lacrymoid to clavate, smooth, hyaline, inamyloid. *Basidia* 20-25 × 6-8 µm, clavate, 4-spored. *Basidioles* 20-23 × 7-9 µm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body 10-18 (-20) × 6-10 (-11) µm, clavate to broadly clavate, rarely lobed, hyaline to pale yellow, inamyloid, thick-walled; apical setulae 2-5 × 0.5-1 µm, crowded, subcylindrical to conical, subacute to obtuse, rarely forked, yellow, inamyloid, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* weakly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 8-15 (-17) × 6-12 µm, cylindrical to clavate or irregular in outline, hyaline, inamyloid, thin- to thick-walled; apical setulae 3-6 × 0.5-1 µm, cylindrical to conical, pale yellow, weakly dextrinoid, thin-walled. *Pileus trama* interwoven; hyphae 7-11 µm diam, cylindrical, hyaline to pale yellow, dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 3.5-7 µm diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 5-7 µm diam, parallel, cylindrical, smooth, yellowish brown, weakly dextrinoid, thick-walled, non-gelatinous; medullary hyphae parallel, cylindrical, 4-7 µm, smooth, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves and twigs. Indonesia (Java), Malaysia (Selangor).



**Fig.41.** *Marasmius persicinus* (TYS 474 = KLU-M#124). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10 µm.

*Material examined:* Malaysia, Selangor, Pangsun, Mount. Nuang Forest Reserve, N 03° 12.593', E 101 ° 52.575', 319 m, 17 May 2005, Yee-Shin Tan, TYS 474 (KLU-M#124, SFSU); same location, 17 May 2005, Hong-Twu Chan, TYS 481 (KLU-M#125, SFSU).

*Notes:* *Marasmius persicinus*, described from Java, is most closely allied with *M. corneri* (syn. *M. incarnatus*) described from Singapore and recently reported from Thailand (Wannathes *et al.*, 2007). The two species differ primarily in pileus size, number of lamellae, and basidiospore size. *Marasmius persicinus* has pilei 3-10 mm diam, 8-16 lamellae, and basidiospores with mean range 17.7-18.3 × 3.6-4 µm. *Marasmius corneri* has pilei 10-43 mm diam, 12-18 lamellae, and basidiospores with mean range 19-21.8 × 4-4.5 µm.

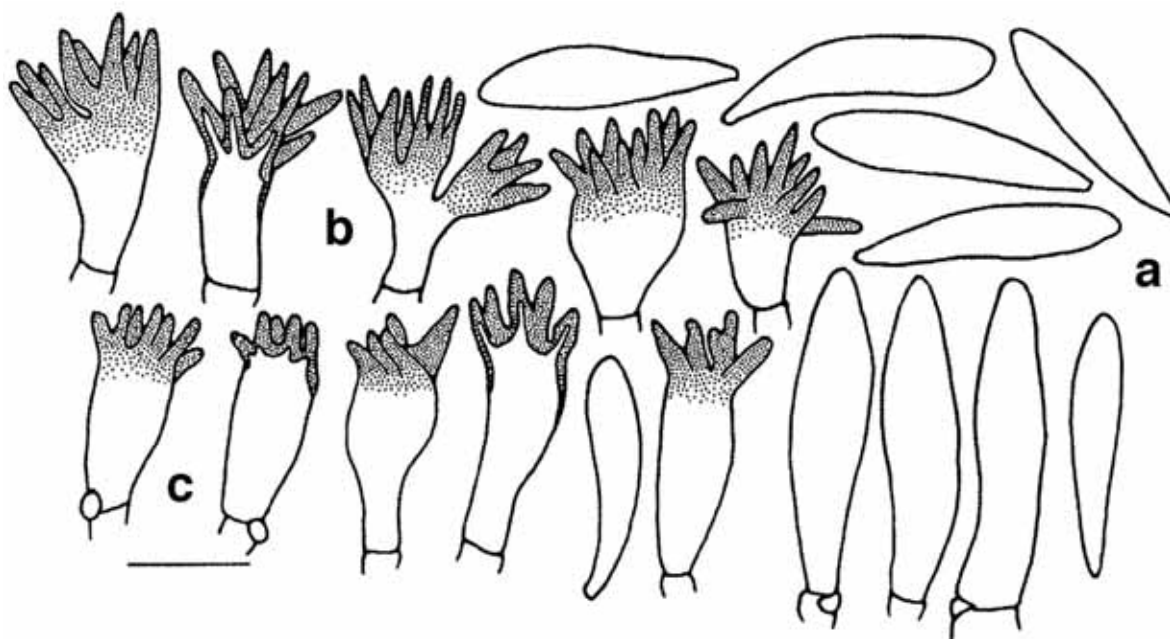
36. *Marasmius corneri* Wannathes, Desjardin & S. Lumyong, Mycol. Res. 111: 992. 2007. (Synonym: *Marasmius incarnatus* Corner, Beih. Nova Hedwigia 111: 60. 1996 [non *Marasmius incarnatus* QuéL., Enchir. Fung.: 142. 1886]. (Fig. 42)

No specimens of *M. corneri* have yet

been collected in Malaysia although the species is suspected to occur here. Corner described *M. incarnatus* from Singapore, but since this epithet is a homonym (non *Marasmius incarnatus* QuéL.), Wannathes *et al.* (2007) proposed the new name *M. corneri* for the species and reported a bipolar (unifactorial) mating system based on specimens from Thailand.

#### **Type study of *Marasmius incarnatus*:**

The holotype specimen (Singapore, Gardens Jungle, 8 Aug. 1940, Corner s.n., E #206722) consists of approx. 16 basidiomes in good condition, loose or attached to leaves of misc. dicots. As dried: *Pileus* 4-15 mm diam, obtusely conical, with a small umbo, sulcate, minutely subvelutinous, orangish brown (not pale). *Lamellae* adnexed, non-collariate, distant, usually with no lamellulae, broad, pale orangish brown, edges concolorous. *Stipe* 18-25 × 0.5-1 mm, central, terete, cylindrical, non-insititious, arising from orangish cream or brownish orange mycelium; pale brown overall; *rhizomorphs* absent.



**Fig.42.** *Marasmius incarnatus* (Holotype: E#206722). a. Basidiospores. b. Cheilocystidia. c. Pileipellis. Bar = 10 µm.

*Basidiospores* 19-24 × 3.5-4.5 µm, elongate-clavate, sometimes curved, smooth, hyaline, inamyloid, thin-walled, typically with a thick refractive region at the apiculus. *Basidia* not observed. *Basidioles* 22-27 × 5.5-7 µm, subfusoid. *Cheilocystidia* abundant, edge mostly sterile, composed of *Siccus*-type broom cells; main body 10-17 × 4.5-8.5 µm, clavate to subcylindrical, hyaline, inamyloid, thin-walled; apical setulae 2-4 (-6.5) × 0.5-1.8 µm, conical to irregular in outline, often wavy or with a few nodules, obtuse to subacute, pale yellow, inamyloid, thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 8-16 × 5.5-9.5 µm, subcylindrical to clavate or irregular in outline, sometimes lobed, hyaline, inamyloid, thin-walled or apically thick-walled; apical setulae 3-8 × 0.5-1.8 µm, narrowly conical, subacute, yellow to golden, weakly dextrinoid, thick-walled; some cells with longer, more thickly walled and darker pigmented setulae. *Pileus trama* weakly dextrinoid; *lamellar trama* dextrinoid. *Stipe tissue* monomitic; cortical hyphae 2-5 µm diam, parallel, cylindrical, golden, strongly dextrinoid; medullary hyphae hyaline, dextrinoid. *Caulocystidia* absent. *Clamp connections* present.

*Notes:* *Marasmius corneri* is phenetically very close to *M. persicinus*. See there for a comparison.

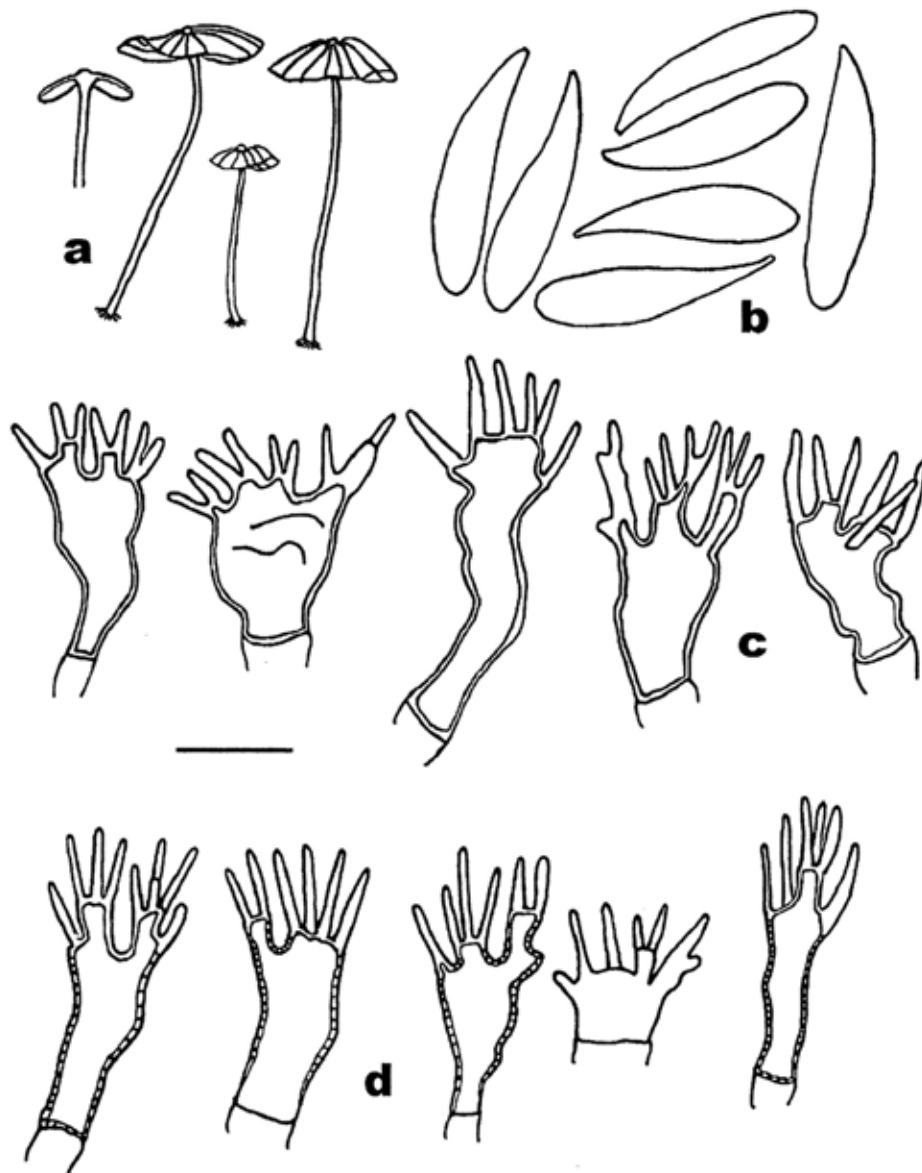
37. *Marasmius selangorensis* Y.S. Tan & Desjardin, Fungal Diversity 25: 196. 2007.

(Fig. 43, Plate 3J)

Type: Malaysia, Selangor, Hulu Langat, Sungai Chongkak Forest Reserve, 15 May 2005, Y.S. Tan #453 (KLU-M #4!).

*Pileus* 10-23 mm diam, paraboloid to obtusely conical, convex or broadly convex and umbonate; disc wrinkled; margin sulcate to plicate; surface dry, dull, minutely velutinous; brown (6E8) to dark brown (6F8) with reddish tones overall when young, gradually becoming yellowish brown (5D5-8, 5E8), light brown (6D5-6), grayish orange (5B4-5), brownish orange (6C5), pinkish brown, or golden brown (5D7) on the margin with a dark brown disc. *Lamellae* adnate, distant (12-18) with no lamellulae, narrow, orangish white with brown edges. *Stipe* 19-43 × 0.5-1 mm, central, terete, equal, tough, dry, dull, glabrous, non-insititious, base with strigose, yellowish white mycelium; when young apex yellowish white to pale orange with a deep orange base, in age becoming yellowish white at apex, gradually grading to orange, brownish orange, brown or dark brown at the base. *Odor* pleasant.

*Basidiospores* (17-) 18-24 (-25) × (3.5-) 4-5 µm [ $x_{mr} = 19.2-21.3 \times 4-4.3 \mu\text{m}$ ,  $x_{mm} = 20.9 \pm 1.0 \times 4.1 \pm 0.2 \mu\text{m}$ ,  $Q = 4-6.3$ ,  $Q_{mr} = 4.9-5.3$ ,  $Q_{mm} = 5.0 \pm 0.1$ ,  $n = 30-40$  spores per 3 collections], fusoid to clavate, smooth, hyaline,



**Fig. 43.** *Marasmius selangorensis* (Holotype: TYS 453 = KLU-M #4). a. Basidiomes. b. Basidiospores. c. Cheilocystidia. d. Pileipellis. Bars: a = 10 mm, b-d = 10  $\mu$ m.

inamyloid, thin-walled. *Basidia* not observed. *Basidioles* 22-30  $\times$  6-8  $\mu$ m, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (7-) 10-16 (-20)  $\times$  6-10 (-13)  $\mu$ m, subcylindrical to clavate, broadly clavate or irregular in outline, seldom lobed, hyaline, inamyloid, thick-walled; apical setulae 4-12  $\times$  1-2  $\mu$ m, crowded, cylindrical to conical, subacute to obtuse, sometimes forked, light yellow to yellow or light brown, inamyloid, thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 7-20  $\times$  5-8  $\mu$ m, cylindrical to clavate or subclavate, sometimes lobed, light yellow, inamyloid, thick-walled; apical setulae 7-15  $\times$  1-4  $\mu$ m, numerous, cylindrical to conical,

rarely forked, yellow to brownish yellow or brown, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae 4-8  $\mu$ m diam, hyaline, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 4-8  $\mu$ m diam, cylindrical, hyaline to light yellow, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 3-9  $\mu$ m diam, parallel, cylindrical, smooth, yellow at apex, brownish yellow at base, weakly dextrinoid to dextrinoid, thick-walled (0.5-1  $\mu$ m); medullary hyphae 4-10  $\mu$ m diam, parallel, cylindrical, smooth, light yellow, dextrinoid, thin-walled or with walls up to 0.5  $\mu$ m thick. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Malaysia (Selangor, Selayang).

*Material examined:* Malaysia, Selangor, Hulu Langat, Sungai Chongkak Forest Reserve, 15 May 2005, Yee-Shin Tan, TYS 453 (**Holotype:** KLU-M #4; **Isotype:** SFSU); same location, 15 May 2005, Yee-Shin Tan, TYS 454 (KLU-M #5, SFSU); same location, 16 May 2005, Yee-Shin Tan, TYS 462 (KLU-M #6, SFSU); Selayang, Kanching Forest Reserve, 9 Jan 2005, Yee-Shin Tan, TYS 435 (KLU-M#99, SFSU).

*Notes:* *Marasmius selangorensis* is characterized by the following features: a brown to light brown or pinkish brown, sulcate pileus with wrinkled disc; distant (12-18), orange-white, narrow lamellae with brown edges; a brownish orange to reddish brown, glabrous stipe 20-40 mm long, arising from yellowish white basal mycelium; clavate basidiospores in the range  $18-24 \times 4-5 \mu\text{m}$  (mean  $20.9 \times 4.1 \mu\text{m}$ ); *Siccus*-type cheilocystidia and pileipellis broom cells with setulae up to  $12 \mu\text{m}$  long; an absence of pleurocystidia and caulocystidia; and growth on dicotyledonous leaves. *Marasmius selangorensis* is allied with *M. adhaesus* and *M. aciebrunneus* from Malaysia, and with *M. sierraleonis* Beeli and *M. carcharus* Singer from Africa. *Marasmius adhaesus* differs in forming a pileus with olivaceous tones (fuliginous olive, brownish olive) and has longer basidiospores in the range  $25-30 \times 3-5 \mu\text{m}$  (Corner, 1996; E!). *Marasmius aciebrunneus* differs primarily in forming pilei with ferruginous or orange and yellow colours, and has slightly longer basidiospores ( $22-26 \times 4-5 \mu\text{m}$ ; Corner, 1996; E!). *Marasmius sierraleonis* differs in forming dull yellow to rusty brown pilei, has a longer stipe (35-70 mm), smaller basidiospores ( $15.5-20 \times 3.5-4.7 \mu\text{m}$  with mean  $17.5 \times 4 \mu\text{m}$ ) and growth on twigs (Pegler, 1977; Antonín, 2007). *Marasmius carcharus* differs in forming much broader lamellae (6-7 mm) that are non-marginate, has a longer stipe (30-70 mm), and smaller basidiospores ( $16-23.5 \times 2.3-3.7 \mu\text{m}$  with mean  $17 \times 3 \mu\text{m}$ ; Singer, 1965; Pegler, 1977).

A bipolar (unifactorial) mating system was reported for *M. selangorensis* by Tan *et al.* (2007).

38. *Marasmius kanchingensis* Y.S. Tan & Desjardin, **sp. nov.** (Fig. 44)

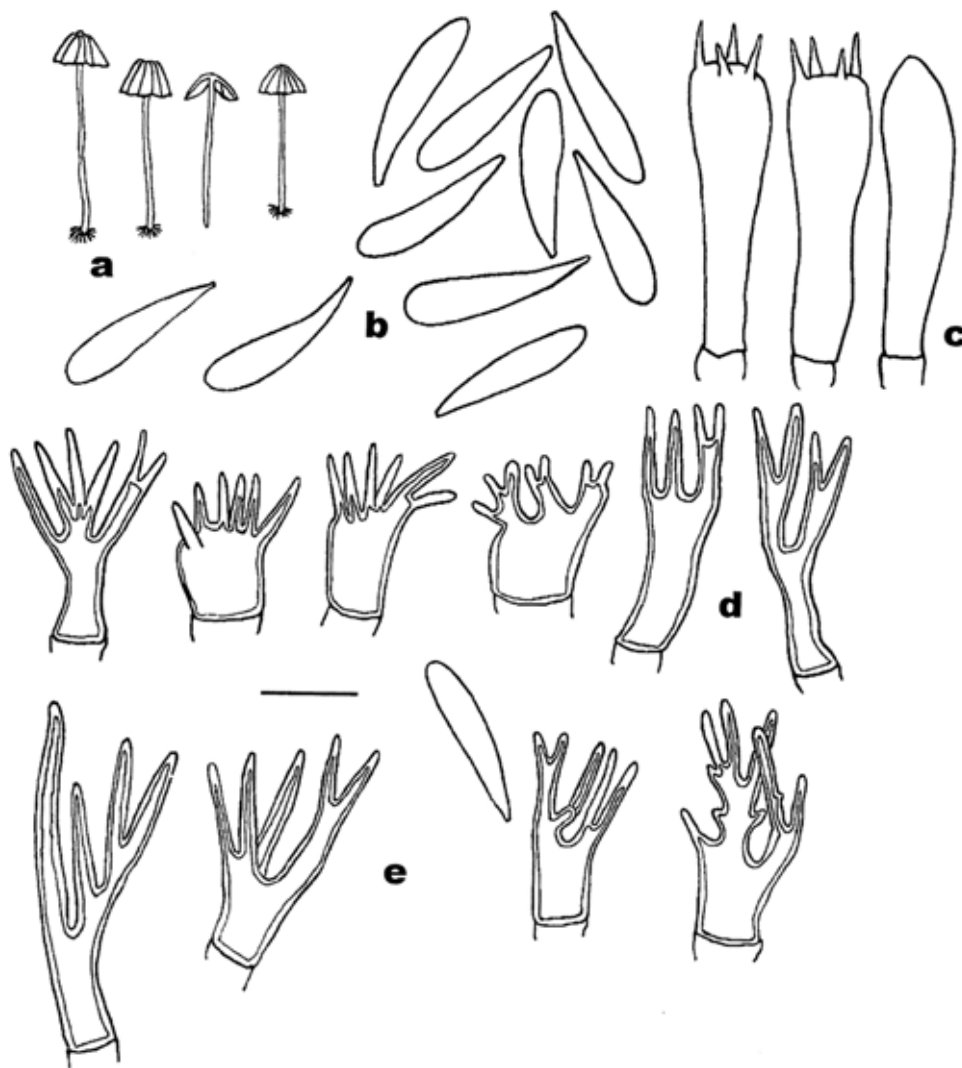
Mycobank: MB 512631

*Etymology:* *kanching-* = Kanching, *-ensis* = origin, referring to the Kanching Forest Reserve where the holotype was collected.

*Pileus* 2-12 mm latus, conicus vel convexus, umbonatus, sulcatus, velutinus, aurantio-brunneus vel atrobunneus. Lamellae adnatae, subdistantes (14-16), haud intervenosae, aurantio-albae, brunneo-marginatae. Stipes 11-35  $\times$  0.5 mm, cylindricus, glabrus, haud insititius, apicaliter pallide aurantiacus, basim atrobunneus, ad basim tomento pallide brunneo strigosoque affixus. Basidiosporae 17-22  $\times$  3.5-5.5  $\mu\text{m}$ , fusiodeae vel clavatae, leves, hyalinae, inamyloideae. Basidia 31-33  $\times$  8-9  $\mu\text{m}$ , clavatae, 4-spora. Cheilocystidia typi Sicci, 10-16  $\times$  4-8  $\mu\text{m}$ , clavata vel late clavata, straminea, crasse-tunicata; setulae ad apicem 6-12  $\times$  1-1.5  $\mu\text{m}$ , angusti-cylindricae vel conicae, subacutae, flavae, inamyloideae, crasse-tunicatae. Pleurocystidia nulla. Pileipellis hymeniformis, typi Sicci, cellulae 10-16  $\times$  6-11  $\mu\text{m}$ , cylindricae vel late clavatae, stramineae, inamyloideae, crasse-tunicatae; setulae ad apicem 5-12  $\times$  0.5-1.5  $\mu\text{m}$ , cylindricae vel conicae, subacutae, flavae vel brunneo-flavae, inamyloideae, crasse-tunicatae. Caulocystidia nulla. Fibulae presentes. Gregarius ad folia putrida plantarum dicotyledonearum. Holotypus: Malaysia, Selangor, Selayang, Kanching Forest Reserve, 8 Jan 2005, Yee-Shin Tan, TYS 415 (Holotypus: KLU-M#74).

*Pileus* 2-12 mm diam, paraboloid to obtusely conical or convex, umbonate; margin sulcate; surface dull, dry, velutinous; grayish orange (6B6) to brownish orange (5C6-7) when young, dark brown (7F8) to brown (6E8) with pale grayish orange (6B4) stripes margin in age. *Lamellae* narrowly adnate, subdistant (14-16) with no lamellulae, not intervenose, orangish white (6A2) with brown edge. *Stipe* 11-35  $\times$  0.5 mm, central, terete, cylindrical, equal, tough, dry, dull, glabrous, non-insititious, orangish white (5A2) at apex, dark brown (7F7-8) at base, with strigose, light brown basal mycelium. *Odor* not distinctive.

*Basidiospores* (16-) 17-22  $\times$  3.5-5.5  $\mu\text{m}$  [ $x_{mr} = 18.5-20.5 \times 4 \mu\text{m}$ ,  $x_{mm} = 19.5 \pm 1.4 \times 4 \pm 0.0 \mu\text{m}$ ,  $Q = 3.8-5.3$ ,  $Q_{mr} = 4.7-5.2$ ,  $Q_{mm} = 5 \pm 0.3$ ,  $n = 25$  spores per 2 specimens], narrowly elongated to fusoid or clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* 31-33  $\times$  8-9  $\mu\text{m}$ , clavate, 4-spored. *Basidioles* 28-29  $\times$  6-7  $\mu\text{m}$ , fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (8-) 10-16 (-22)  $\times$  4-8 (-10)  $\mu\text{m}$ , clavate



**Fig.44.** *Marasmius kanchingensis* (Holotype: TYS 415 = KLU-M#74). a. Basidiomes. b. Basidiospores. c. Basidia and basidiole. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.

to broadly clavate or irregular in outline, rarely lobed, light yellow, inamyloid, thick-walled; apical setulae (4-) 6-12 (-15)  $\times$  1-1.5  $\mu$ m, narrowly cylindrical to conical, subacute, rarely forked, yellow, inamyloid, thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (8-) 10-16 (-17)  $\times$  (5-) 6-11 (-13)  $\mu$ m, cylindrical to clavate, broadly clavate or irregular in outline, lobed, light yellow, inamyloid, thick-walled; apical setulae (3-) 5-12 (-23)  $\times$  0.5-1.5 (-2)  $\mu$ m, narrowly cylindrical to conical, subacute, rarely forked, yellow to brownish yellow, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae 2.5-5  $\mu$ m diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 5-11  $\mu$ m diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic;

cortical hyphae 6-9  $\mu$ m diam, parallel, cylindrical, smooth, brownish yellow (apex) to brown (base), weakly dextrinoid, thick-walled, non-gelatinous; medullary hyphae 3-10  $\mu$ m diam, parallel, cylindrical, smooth, hyaline, dextrinoid, thick-walled, non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Malaysia (Selangor).

*Material examined:* Malaysia, Selangor, Selayang, Kanching Forest Reserve, N 03° 17.958', E 101° 37.151', elev. 110m, 8 Jan 2005, Yee-Shin Tan, TYS 415 (**Holotype:** KLU-M#74; **Isotype:** SFSU); same location, 9 Jan, 2005, Dennis Desjardin, TYS 428 (KLU-M#75, SFSU).

*Notes:* Distinctive features of *M. kanchingensis* include: a small (< 12 mm diam), sulcate and striped pileus coloured brown to brownish orange with pale greyish orange



sulcae; subdistant (10-16) lamellae with brown edges; a glabrous stipe lacking caulocystidia; basidiospores  $17-22 \times 3.5-5.5$  with mean  $19.5 \times 4 \mu\text{m}$ ; narrowly conical, acute setulae 5-12  $\mu\text{m}$  long (or longer) on *Siccus*-type broom cells; and growth on dicotyledonous leaves. The new species is similar to *M. striaepileus* Antonin from Burundi, *M. phaeus* Berk. & M. A. Curtis from Cuba, *M. bambusiniformis* and *M. selangorensis*. *Marasmius striaepileus* differs in forming larger (15-30 mm diam) pilei, slightly smaller basidiospores ( $15.5-18.5 \times 3.5-5 \mu\text{m}$ ) and is lignicolous (Antonin, 2007). *Marasmius phaeus* differs in forming broom cells with shorter setulae (5-8.5  $\mu\text{m}$ ), is lignicolous and New World in origin (Singer, 1976). *Marasmius bambusiniformis* differs in forming a paler, non-striped pileus, slightly smaller basidiospores ( $15-18 \times 3-4.5 \mu\text{m}$ ), and broom cells with much smaller setulae (2-5  $\mu\text{m}$  long). *Marasmius selangorensis* differs in forming a pileus with more pink to reddish brown tones and larger basidiospores ( $18-24 \times 4-5 \mu\text{m}$  with mean  $21 \times 4 \mu\text{m}$ ). In the phylogenetic tree, *M. kanchingensis* and *M. selangorensis* are sister taxa with 1.0 PP support, but *M. kanchingensis* is on a long branch.

**39. *Marasmius aratus*** Masee, Bull. Misc. Inform. 10: 358. 1914. nom. illegit. non *Marasmius aratus* W.G. Sm., Lond. J. Bot. 11: 66. 1873. (Fig. 45 & 46, Plate 3L)

Type: Singapore, E. M. Burkill #113 (K).

*Pileus* 4-13 (-18) mm diam, convex to obtusely conical or broadly convex with a small umbo; margin sulcate to plicate; surface dry, dull, hygrophanous, minutely velutinous; blood red to deep brownish purple, drying deep reddish brown with a hint of burgundy. *Lamellae* adnate to subfree, distant (10-16) with no lamellulae, broad, yellowish white, non-marginate. *Stipe* 6-17  $\times$  0.2-0.5 mm, central, cylindrical, terete, equal, dry, dull, glabrous, non-insititious, yellowish white to pink at the apex, dark brown on the base, arising from white mycelium and accompanied by yellowish white, wiry *rhizomorphs*.

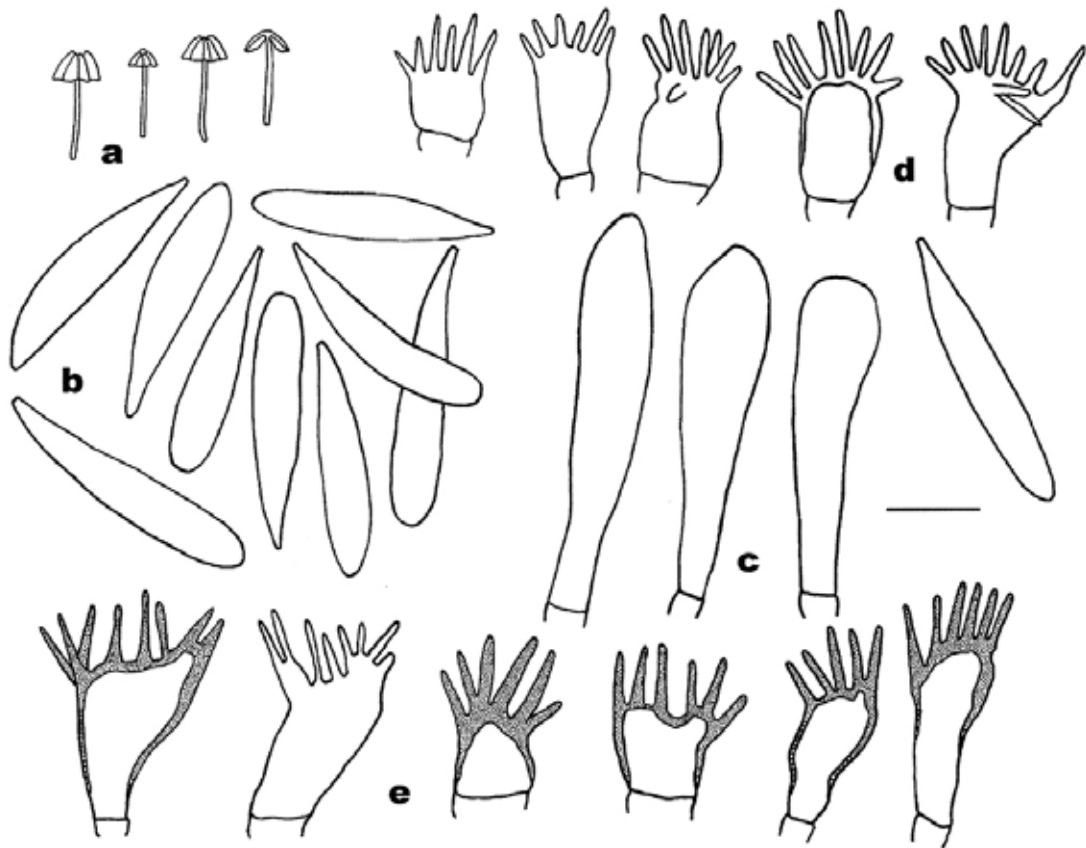
*Basidiospores*  $22-32 \times 3.5-5 \mu\text{m}$  [ $x_{mr} = 26.4-29.8 \times 3.7-4.6 \mu\text{m}$ ,  $x_{mm} = 27 \pm 0.8 \times 4.1 \pm 0.6 \mu\text{m}$ ,  $Q = 5.4-8.3$ ,  $Q_{mr} = 5.8-6.8$ ,  $Q_{mm} = 6.4 \pm$

$0.8$ ,  $n = 25-27$  spores per 4 specimens], elongate-lacrymoid to clavate, sometimes curved, smooth, hyaline, inamyloid. *Basidia* not observed. *Basidioles*  $32-40 \times 7 \mu\text{m}$ , fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (10-) 14-20 (-22)  $\times$  5-10  $\mu\text{m}$ , subcylindrical to clavate or broadly clavate, rarely lobed, hyaline, inamyloid, thin-walled; apical setulae (4-) 6-10  $\times$  0.5-1.5  $\mu\text{m}$ , crowded, cylindrical to conical, acute to subacute, rarely forked, pale yellow to yellow, dextrinoid, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* strongly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (8-) 12-30  $\times$  5-11  $\mu\text{m}$ , cylindrical to clavate or irregular in outline, hyaline to pale yellow, inamyloid, thin- to thick-walled; apical setulae (2.5-) 4-8  $\times$  0.5-1.5  $\mu\text{m}$ , crowded, cylindrical to conical, hyaline to tawny brown, weakly dextrinoid, thick-walled. *Pileus trama* interwoven; hyphae 5-6  $\mu\text{m}$  diam, cylindrical, hyaline, inamyloid to dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 5-8  $\mu\text{m}$  diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 3-7  $\mu\text{m}$  diam, parallel, cylindrical, smooth, yellow (apex) to dark brown (base), dextrinoid, thick-walled; medullary hyphae parallel, cylindrical, 5-9  $\mu\text{m}$ , smooth, pale yellow at apex, yellow at base, weakly dextrinoid to dextrinoid, thin-walled. *Caulocystidia* absent. *Clamp connections* present.

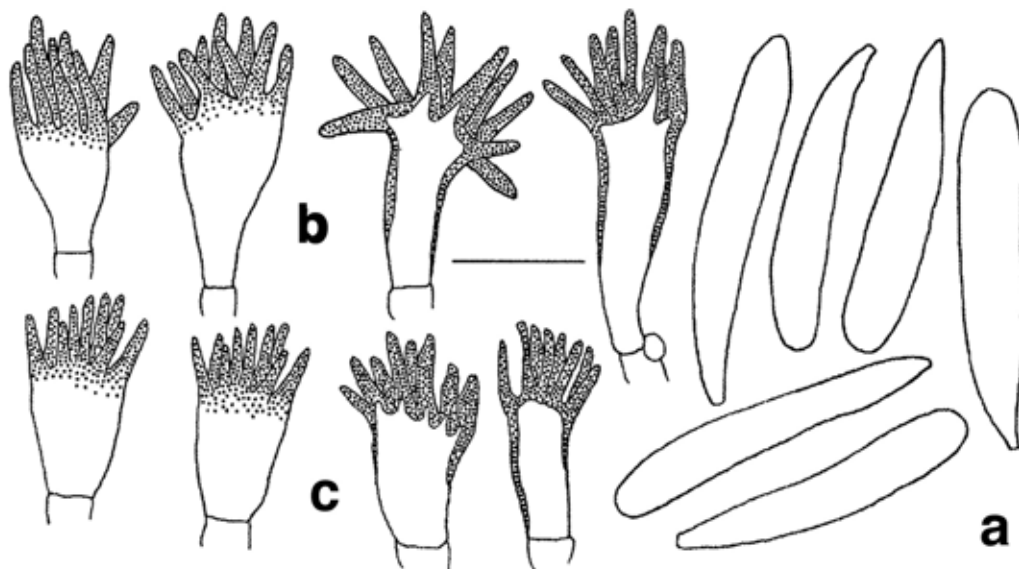
*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves and twigs. Malaysia (Selangor), Singapore.

*Material examined:* Malaysia, Selangor, University of Malaya's Field Study Centre, 20 Apr 2003 Yee-Shin Tan, KUM 152 (KLU-M#38, SFSU); Selangor, Selayang, Kanching Forest Reserve, N 03°17. 958', E 101°37. 151', 8 Jan 2005, Yee-Shin Tan, TYS 409 (KLU-M#40). Singapore, Reservoir Jungle, 5 Aug. 1940, Corner s.n. (E #205864); Singapore, Botanic Garden, 9 Aug. 1940, Corner s.n. (E #205859).

*Notes:* Our concept of *M. aratus* follows that of Corner (1996) based on toprototypical material that he collected in Singapore. *Marasmius aratus* is distinguished by a small, blood red, plicate pileus, distant (10-16) lamellae, a glabrous stipe that arises from white



**Fig. 45.** *Marasmius aratus* (KUM 152 = KLU-M#38). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 10 mm, b-e = 10  $\mu$ m.



**Fig. 46.** *Marasmius aratus* (E#205859). a. Basidiospores. b. Cheilocystidia. c. Pileipellis. Bar = 10  $\mu$ m.

mycelium and is associated with yellowish white, wiry rhizomorphs, and very long basidiospores in the range  $22-32 \times 3.5-5 \mu$ m with mean  $27 \times 4.1 \mu$ m. In the field, *M. aratus* may be mistaken for the typical red form of *M. haematocephalus* commonly encountered in Southeast Asia, but the latter differs in forming

smaller basidiospores with mean range  $16.8-22 \times 4-4.3 \mu$ m and has prominent pleurocystidia.

40. *Marasmius aciebrunneus* Corner, Beih. Nova Hedwigia 111: 24. 1996. (Fig. 47 & 48)

Type: Singapore, Reservoir Jungle, 5 August 1940, Corner s.n. (E #205862!).

*Pileus* 7-20 mm diam, obtusely conical to convex or broadly convex; disc rugulose; margin striate to sulcate; surface dry, dull, velutinous; brown (6-7E6-8) to ferruginous with darker disc. *Lamellae* adnate, subdistant (11-14) with no lamellulae, grayish orange (5B3) with brown edge. *Stipe* 15-22 × 0.5-1 mm, central, cylindrical, terete, equal, dry, dull, glabrous, non-insititious, yellowish white at the apex, gradually change to brownish orange or dark brown on the base, with pale orange strigose basal mycelium; associated with white, wiry *rhizomorphs*.

*Basidiospores* (19-) 20-27 (-30) × (3.2-) 4-5 μm [ $x_{mr} = 23.4-26.9 \times 4.1-4.8 \mu\text{m}$ ,  $x_{mm} = 24.8 \pm 1.9 \times 4.3 \pm 0.6 \mu\text{m}$ ,  $Q = 4.7-6.6$ ,  $Q_{mr} = 5.7-6$ ,  $Q_{mm} = 5.8 \pm 0.2$ ,  $n = 23$  spores per 4 specimens], elongate-lacrimoid to clavate, smooth, hyaline, inamyloid. *Basidia* 23-27 × 5-6 μm, clavate, 4-spored. *Basidioles* 28-32 × 6 μm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (6-) 7-13 (-21) × 5-8 (-10) μm, clavate to broadly clavate, subcylindrical or irregular in outline, rarely lobed, hyaline to light yellow, inamyloid, thick-walled; apical setulae (2-) 3-20 (-12) × 0.5-1 μm, crowded, cylindrical to conical, acute to subacute, rarely forked, light brownish yellow to yellow, inamyloid, thin- to thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body (6-) 7-13 (-19) × 5-9 (-11) μm, cylindrical to clavate or broadly clavate, hyaline to pale yellow, inamyloid, thick-walled; apical setulae (3-) 4-6 × (0.3-) 0.5-1 μm, crowded, cylindrical to conical, light yellow to brownish yellow, acute to subacute inamyloid, thin- to thick-walled. *Pileus trama* interwoven; hyphae 5-9 μm diam, cylindrical, light yellow, strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 4-6 μm diam, cylindrical, hyaline, weakly dextrinoid to dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 6-8 μm diam, parallel, cylindrical, smooth, dull yellow (apex) to brownish yellow (base), weakly dextrinoid, thick-walled; medullary hyphae parallel, cylindrical, 3-8 μm, smooth, hyaline to light yellow, dextrinoid, thin-walled, slightly

gelatinous. *Caulocystidia* absent. *Clamp connections* present.

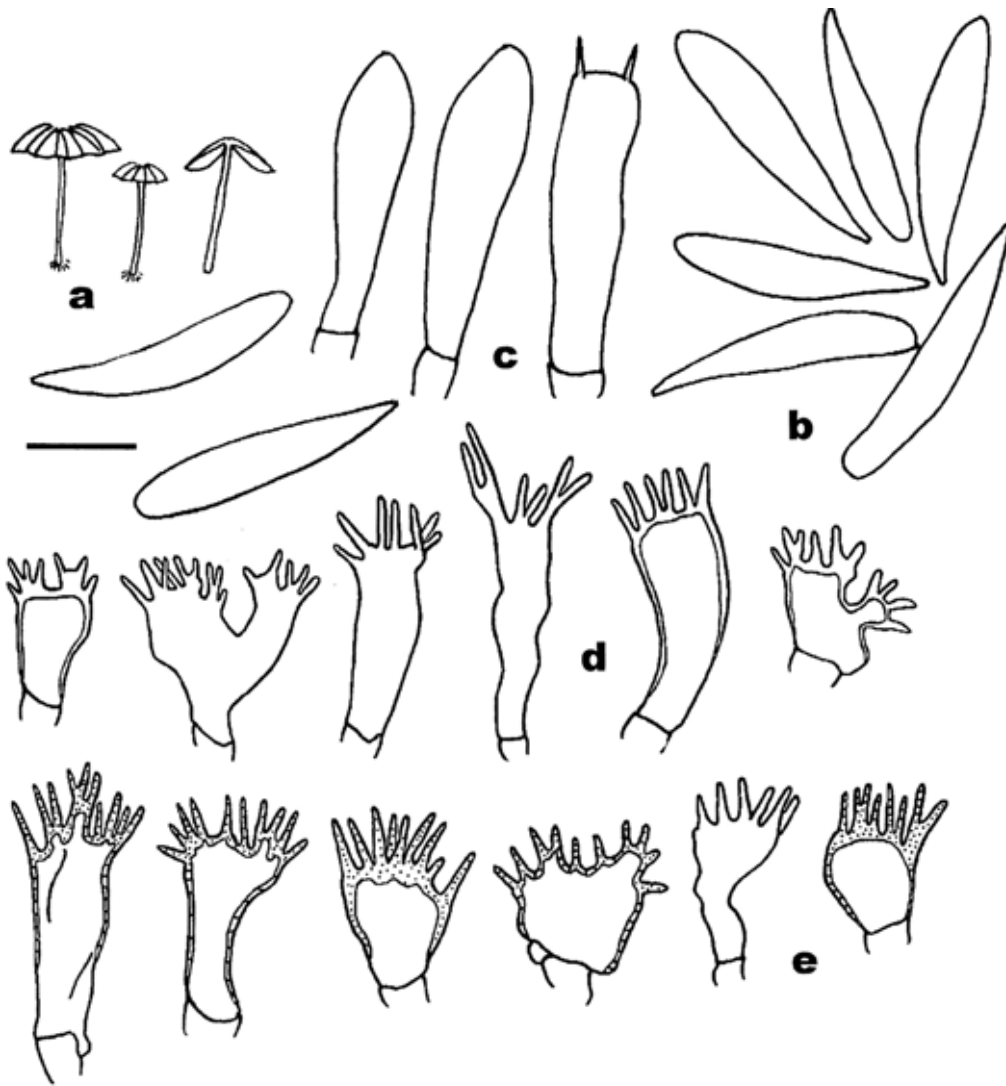
*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves and twigs. Malaysia (Selangor), Singapore.

*Material examined:* Malaysia, Selangor, Hulu Langat, 16 May 2005, Yee-Shin Tan, TYS 457 (KLU-M#30, SFSU); Selangor, University of Malaya's Field Study Centre, 28 July 2003, Yee-Shin Tan, TYS 027 (KLU-M#31, SFSU); same location, 28 July 2003, Yee-Shin Tan, TYS 036 (KLU-M#32, SFSU). Singapore, Reservoir Jungle, 5 August 1940, Corner s.n. (**Holotype:** E #205862).

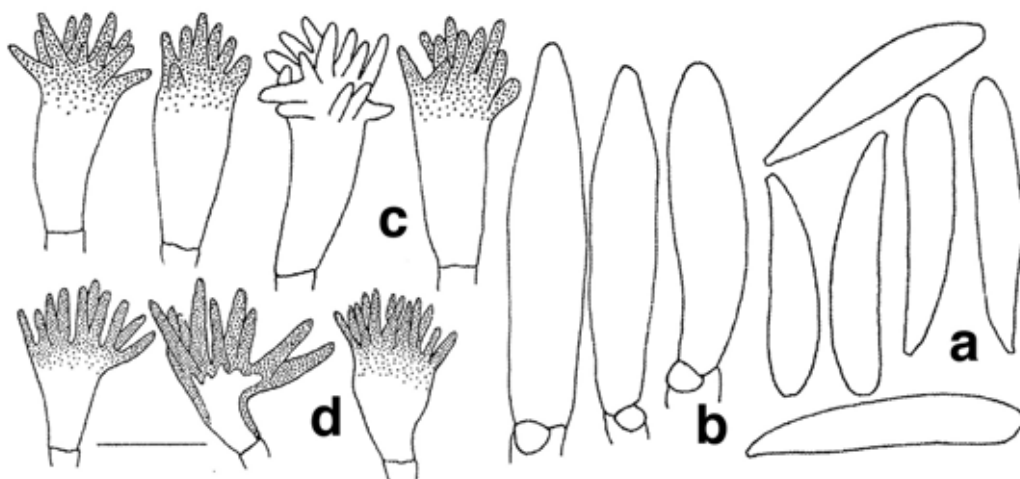
*Notes:* Diagnostic features of *M. aciebrunneus* include: a moderately large, obtusely conical to convex, brown to ferruginous, sulcate pileus; subdistant (11-14) lamellae with brown-edges; a glabrous stipes associated with white, wiry rhizomorphs; long basidiospores in the range 20-27 × 4-5 μm with mean 24.8 × 4.3 μm; and an absence of pleurocystidia. Morphologically, *M. aciebrunneus* is similar to *M. adhaesus*, but the latter differs subtly in forming pilei with olive tones (lacking ferruginous tones), has more lamellae (10-20), and slightly longer basidiospores in the range 25-30 × 3-5 μm with mean 27.9 × 4.4 μm. Interestingly, in the ITS derived phylogeny, the two species are placed in distant clades, with *M. aciebrunneus* sister of *M. aratus* (94% BS, 1.0 PP) and *M. adhaesus* sister of *M. bambusiniiformis* (71% BS, 0.98 PP).

#### **Type Study of *Marasmius aciebrunneus*:**

The holotype specimen (Singapore, Reservoir Jungle, 5 August 1940, Corner s.n., E #205862) consists of approx. 10 basidiomes in good condition, loose or attached to dicot leaves. As dried: *Pileus* 5-13 mm diam, campanulate to plano-convex, disc strongly rugulose, plicate, minutely subvelutinous, dark ferruginous. *Lamellae* adnexed, non-collariate, distant with 0-1 series of lamellulae, broad, cream, edges nearly concolorous. *Stipe* 15-25 × 1 mm, central, terete, cylindrical, glabrous, non-insititious, pale brown overall, arising from white to pale yellowish white basal mycelium.



**Fig. 47.** *Marasmius aciebrunneus* (TYS 457 = KLU-M#30). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 20 mm, b-e = 10  $\mu$ m.



**Fig. 48.** *Marasmius aciebrunneus* (Holotype: E#205862). a. Basidiospores. b. Basidioles. c. Cheilocystidia. d. Pileipellis. Bar = 10  $\mu$ m.

*Basidiospores* 20-26 × 4-5 µm, elongate-clavate to subfusoid, sometimes curved, smooth, hyaline, inamyloid, thin-walled. *Basidia* 4-spored, clavate, few seen. *Basidioles* 28-36 × 5.5-9.5 µm, subfusoid. *Cheilocystidia* abundant, edge mostly sterile, of *Siccus*-type broom cells; main body 12-20 × 5-8 µm, clavate to subcylindrical, hyaline, inamyloid, thin-walled; apical setulae 2.5-5 (-6) × 1-1.5 µm, narrowly conical, subacute, pale golden, inamyloid to weakly dextrinoid, thin- to thick-walled. *Pleurocystidia* absent (no refractive cells seen). *Pileipellis* not mottled or weakly mottled, a hymeniform layer of *Siccus*-type broom cells; main body 9-14 × 6-8 µm, clavate to pyriform or irregular in outline, hyaline, inamyloid, thin-walled or apically thick-walled; apical setulae 2.5-6.5 (-9) × 1-1.5 µm, narrowly conical, subacute, yellowish brown, weakly dextrinoid, thick-walled. *Pileus trama* and *lamellar trama* inamyloid to very weakly dextrinoid. *Stipe tissue* monomitic; cortical hyphae 2-5 µm diam, parallel, cylindrical, pale reddish brown, strongly dextrinoid; medullary hyphae similar but broader and hyaline. *Caulocystidia* absent. *Clamp connections* present.

41. *Marasmius adhaesus* Corner, Beih. Nova Hedwigia 111: 27. 1996.

(Fig. 49 & 50, Plate 3I)

Type: Singapore, Garden's Jungle, 8 Aug. 1940, Corner s.n. (E #205880!).

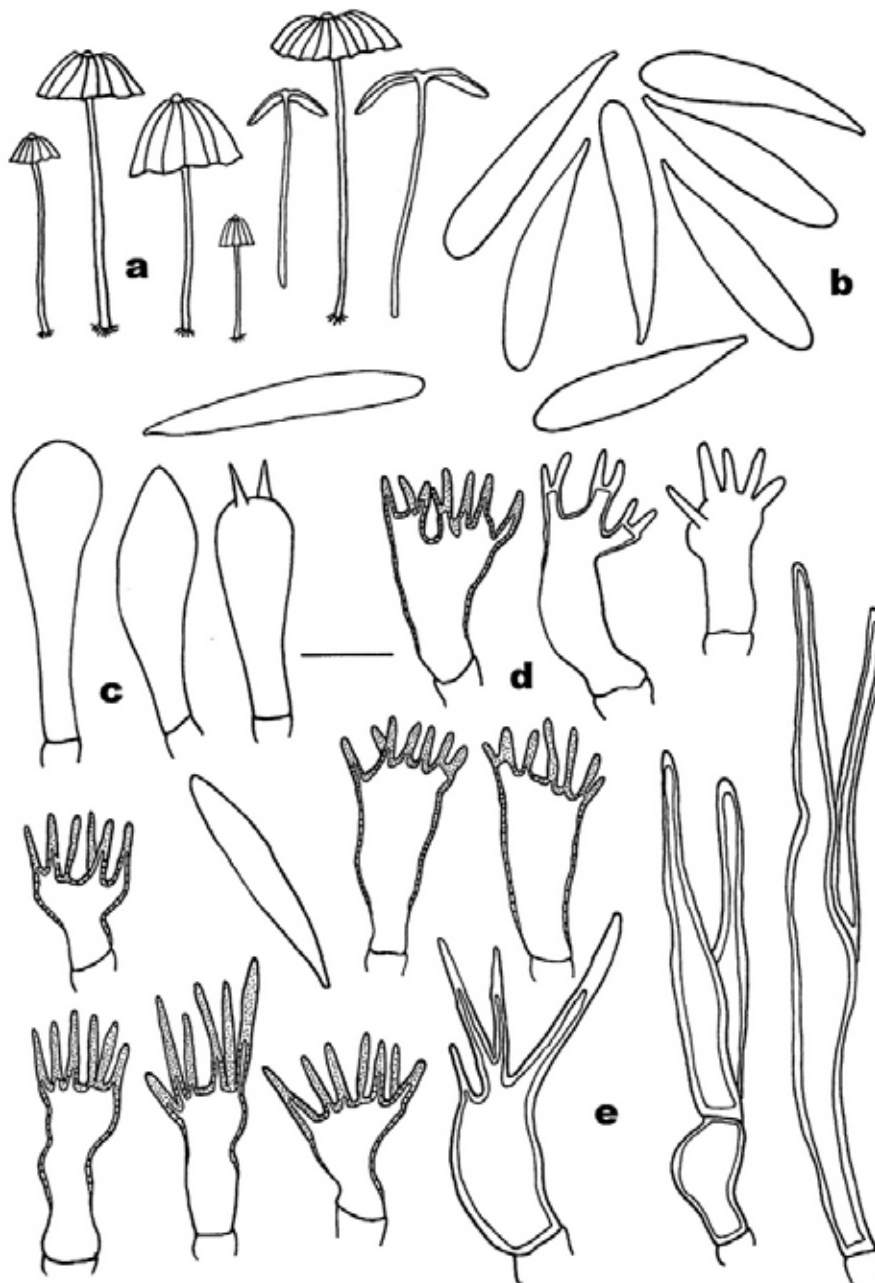
*Pileus* 6-40 mm diam, paraboloid to truncately conical, convex or broadly convex, umbonate; margin sulcate to plicate; surface dry, dull, hygrophanous, minutely velutinous; grayish orange (5B4) to light brown (6D5-8), brownish olive (4E4-6) or brown (6E6-7) with a darker disc. *Context* thin, yellowish white. *Lamellae* narrowly adnate, subdistant (10-20) with no lamellulae, orangish white with light brown edges. *Stipe* 12-55 × 0.5-1 mm, central, cylindrical, terete, equal, dry, dull, glabrous, non-insititious, pale orange (5A3) at the apex, gradually grading to yellow, brownish orange or dark brown at the base, with brownish orange basal mycelium.

*Basidiospores* (21-) 25-30 (-31) × 3-5 µm [ $x_{mr} = 27.6-28.2 \times 4-4.9 \mu\text{m}$ ,  $x_{mm} = 27.9 \pm 0.8 \times 4.4 \pm 0.2 \mu\text{m}$ ,  $Q = 5.6-8.5$ ,  $Q_{mr} = 5.9-7.1$ ,  $Q_{mm} =$

$6.5 \pm 0.6$ ,  $n = 20$  spores per 3 specimens], elongate-lacrimoid to clavate, smooth, hyaline, inamyloid. *Basidia* 24-26 × 6-8 µm, 4-spored. *Basidioles* 25-30 (-34) × 6-9 µm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (8-) 11-20 (-22) × (5-) 7-11 µm, cylindrical to clavate or broadly clavate, hyaline to light yellow, inamyloid, thick-walled; apical setulae (3-) 4-6 (-8) × 0.5-1 (-2) µm, crowded, cylindrical to conical, subacute to obtuse, hyaline, yellow to light brownish yellow, inamyloid, thick-walled. *Pleurocystidia* absent. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells with scattered seta-like cells; main body (8-) 10-20 (-26) × 5-7 (-10) µm, subcylindrical to clavate or subclavate, hyaline, inamyloid, thick-walled; apical setulae (3-) 6-9 (-12) × 0.5-1 µm, cylindrical to conical, light yellow to light brown or brownish yellow, inamyloid, thick-walled. *Seta-like cells* rare, similar to *Siccus*-type broom cells but with only 2-4 very long setulae; main body (10-) 15-30 (-42) × 6-7 µm, cylindrical to subcylindrical, light yellow, inamyloid, thick-walled; apical setulae (15-) 20-33 (-35) × 1.5-3 (-4) µm, brownish yellow, inamyloid, thick-walled. *Pileus trama* interwoven; hyphae 4-10 µm diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae 4-7 µm diam, cylindrical, hyaline, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-7 µm diam, parallel, cylindrical, smooth, light yellow (apex) to yellowish brown (base), inamyloid to weakly dextrinoid, thick-walled (0.5 µm), non-gelatinous; medullary hyphae parallel, 6-11 µm diam, cylindrical, smooth, hyaline, dextrinoid to strongly dextrinoid, thin-walled, weakly gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Malaysia (Selangor), Singapore.

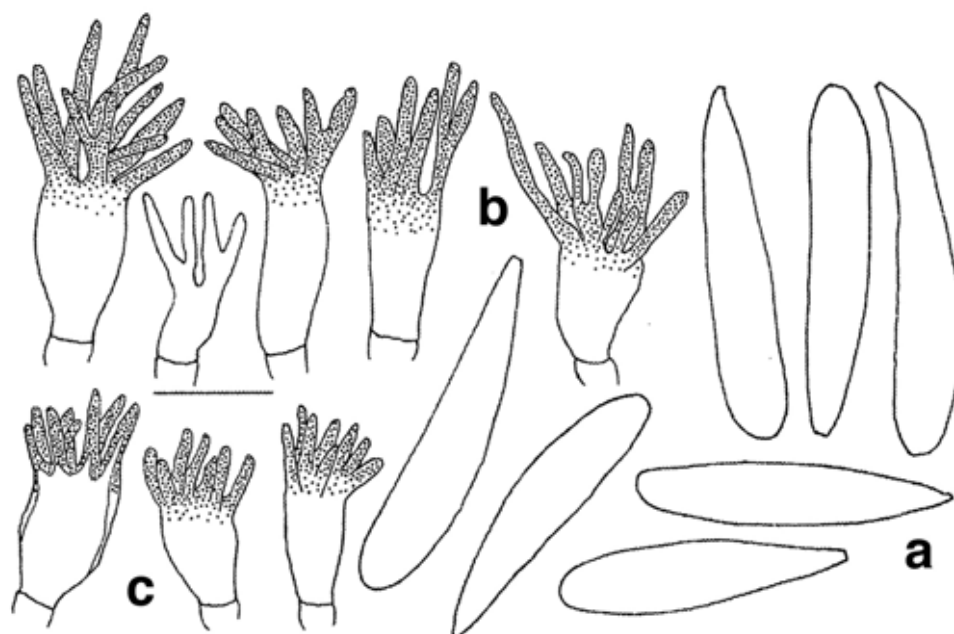
*Material examined:* Malaysia, Selangor, Sungai Chongkak Forest Reserve, N 03°12.705', E 101°50.472', elev. 122 m, 16 May 2005, Yee-Shin Tan, TYS 464 (KLU-M#33, SFSU); same location, 16 May 2005, Yee-Shin Tan, TYS 467 (KLU-M#34, SFSU). Singapore, Garden's Jungle, 8 Aug. 1940, Corner s.n. (**Holotype:** E #205880).



**Fig. 49.** *Marasmius adhaesus* (TYS 464 = KLU-M#36). a. Basidiomes. b. Basidiospores. c. Basidia and basidioles. d. Cheilocystidia. e. Pileipellis. Bars: a = 20 mm, b-e = 10  $\mu$ m.

*Notes:* *Marasmius adhaesus* is characterized by a truncately conical to convex, light brown to brownish olive, sulcate-plicate pileus; subdistant (10-20) lamellae with brown edges; a glabrous stipe lacking caulocystidia; basidiospores in the range of  $25-30 \times 3-5 \mu$ m with mean  $27.9 \times 4.4 \mu$ m; an absence of pleurocystidia; a few seta-like cells in the pileipellis with 2-4 setulae  $15-30 \mu$ m long; and growth on the dicotyledonous leaves.

*Marasmius adhaesus* is similar to the sympatric species *M. selangorensis* but the latter differs in forming pilei with reddish brown to golden brown tones (not olive), smaller basidiospores in the range  $18-24 \times 3.5-5 \mu$ m with mean  $20.9 \times 4.1 \mu$ m, and pileipellis broom cells with numerous setulae  $7-15 \mu$ m long (seta-like cells with setulae  $15-30 \mu$ m long are absent). For a comparison of *M. adhaesus* to *M. aciebrunneus*, see the notes on the latter species.



**Fig. 50.** *Marasmius adhaesus* (Holotype: E#205880). a. Basidiospores. b. Cheilocystidia. c. Pileipellis. Bar = 10  $\mu$ m.

#### Type study of *Marasmius adhaesus*:

Corner originally labeled the packet *M. adhaerens*, but apparently changed it to *M. adhaesus* at time of publication. The holotype specimen (Singapore, Garden's Jungle, 8 Aug. 1940, Corner s.n., E #205880) consists of approx. 8 fragmented basidiomes in fair condition, loose or attached to dicot leaves. As dried: *Pileus* 10-22 mm diam, plano-convex, plicate, glabrous, evenly brown. *Lamellae* adnexed, not collariate, distant with no lamellulae, broad, pale brown. *Stipe* 25-40  $\times$  1 mm, central, cylindrical, non-insititious, arising from cream-coloured, strigose basal mycelium, glabrous, brown; no rhizomorphs.

*Basidiospores* 25-30.5  $\times$  4.3-5.5  $\mu$ m [ $x = 27.6 \times 4.9 \mu$ m], elongate-clavate, smooth, hyaline, inamyloid, thin-walled. Hymenial cells poorly reviving. *Basidia* not seen. *Basidioles* 40  $\times$  8-10  $\mu$ m, clavate to subfusoid. *Cheilocystidia* abundant, edge mostly sterile, of *Siccus*-type broom cells; main body 6.5-20  $\times$  5-10  $\mu$ m, subcylindrical to clavate, sometimes lobed, hyaline, inamyloid, thin-walled; apical setulae 4-14(-19)  $\times$  1-2  $\mu$ m, irregularly cylindrical to subconical, sometimes furcate, acute, brown, thick-walled. *Pleurocystidia* absent. *Pileipellis* not mottled, a hymeniform layer of *Siccus*-type broom cells; main body 8-16  $\times$  5-8  $\mu$ m, subcylindrical to clavate, hyaline and thin-walled at base, apically pale brown

and thick-walled, inamyloid; apical setulae 3-6.5(-8)  $\times$  0.5-1.5  $\mu$ m, narrowly conical, rarely furcate, acute, brown, inamyloid, thick-walled; with a few scattered seta-like cells. *Pileus trama* strongly dextrinoid. *Lamellar trama* dextrinoid. *Stipe tissue* monomitic; cortical hyphae 3-6.5  $\mu$ m diam, parallel, cylindrical, pale yellowish brown, strongly dextrinoid; medullary hyphae 3-8  $\mu$ m diam, hyaline, dextrinoid, thin-walled. *Caulocystidia* absent. *Clamp connections* present.

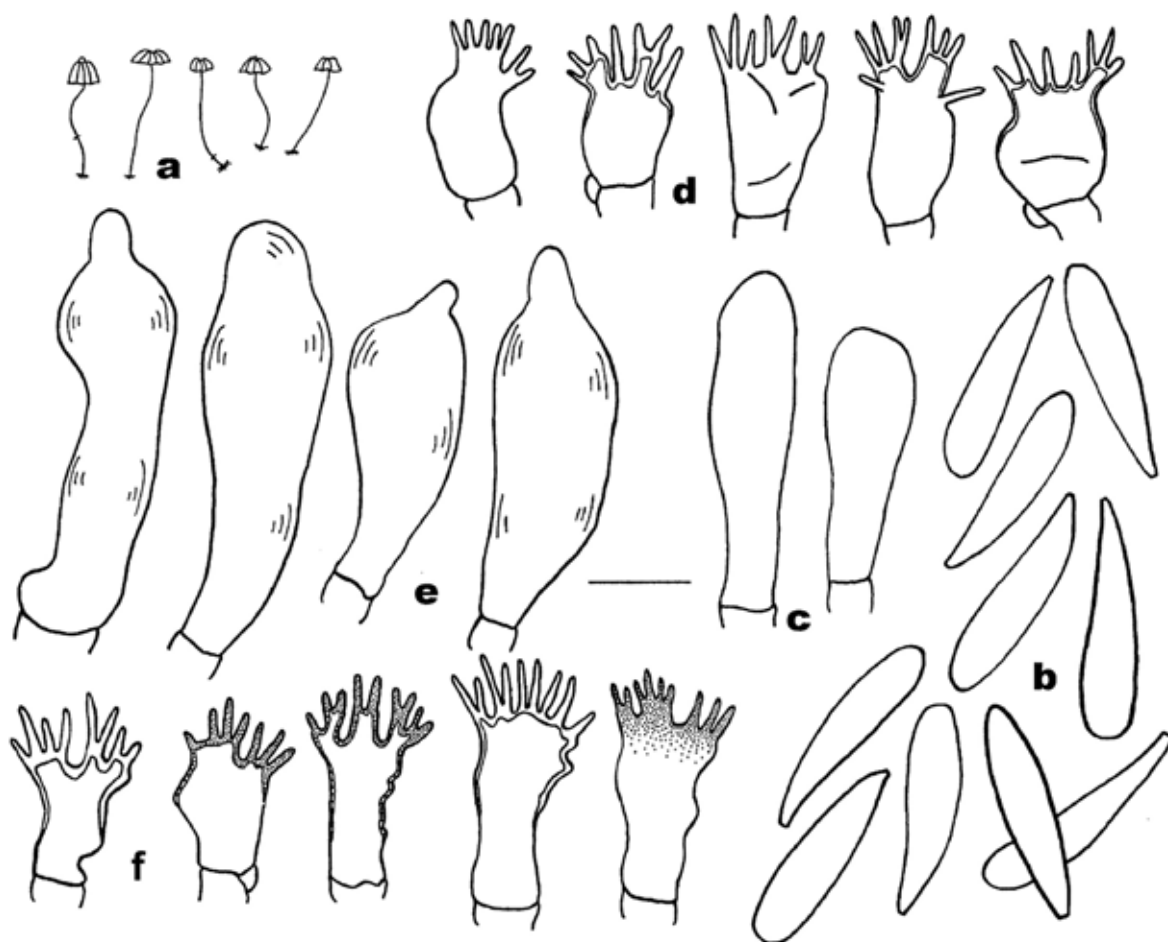
***Marasmius* sect. *Sicci* Singer, subsect. *Siccini* Singer, ser. *Haematocephali* Singer, Fl. Neotrop. Monogr. 17: 201. 1976.**

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

**42. *Marasmius distantifolius* Y.S. Tan & Desjardin, sp. nov.** (Fig. 51, Plate 3H)  
Mycobank: MB 512632

*Etymology*: *distans-* (Latin) = distant; *-folius* (Latin) = leaf, referring to the distant lamellae.

*Pileus* 2-8 mm latus, conico-umbonatus vel late convexus, papillatus, striatus vel sulcatus, subvelutinus, brunneo-rufus, brunneo-violaceus vel griseo-rufus. *Lamellae* adnatae, distantes (7-8), pallide incarnatae, rubri-marginatae. *Stipes* 11-12  $\times$  0.1-0.2 mm, cylindricus, glabrus, haud insititius, apicaliter pallide rufus, basim atrobrunneus, ad basim tomento albido affixus. *Basidiosporae* 18.5-23  $\times$  3.5-5  $\mu$ m, fusiodeae, hyalinae, inamyloideae. *Basidiola* 23-30  $\times$  6-7  $\mu$ m, clavatae vel fusiodeae. *Cheilocystidia* typi Sicci, 10-25  $\times$  5-10  $\mu$ m, clavata, hyalina; setulae ad apicem 3-6  $\times$  0.5  $\mu$ m, densae, cylindricae vel conicae, subacutae vel obtusae,



**Fig. 51.** *Marasmius distantifolius* (Holotype: TYS 478 = KLU-M#72). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pleurocystidia. f. Pileipellis. Bars: a = 20 mm, b-f = 10  $\mu$ m.

stramineae, inamyloideae, tenui-tunicatae. Pleurocystidia rara, 37-42  $\times$  9-12  $\mu$ m, fusiodea vel clavata, mucronata, flavida, inamyloidea, tenui-tunicata. Pileipellis hymeniformis, typi Sicci, cellulae 7-17  $\times$  6-10  $\mu$ m, cylindricae vel clavatae, hyalinae, dextrinoideae, crasse-tunicatae; setulae ad apicem 3.5-6  $\times$  0.5-1  $\mu$ m, densae, cylindricae vel conicae, acutae vel subacutae, fulvae, dextrinoideae. Caulocystidia nulla. Fibulae presentes. Gregarius, ad folia putrida plantarum dicotyledonearum. Holotypus: Malaysia, Selangor, Pangsun, Mount Nuang Forest Reserve, 17 May 2005, Yee-Shin Tan, TYS 478 (Holotypus: KLU-M#72).

*Pileus* 2-8 mm broad, obtusely conical with umbonate disc when young, expanding in age to convex or broadly convex-depressed with an acute papilla; margin striate to sulcate; surface dull, dry, subvelutinous; brownish red (10D7-8) to brownish violet (11D7-8) or greyish red (10C5), with ruby to pinkish brown tones, not violet. *Lamellae* adnate, distant (7-8) with no lamellulae, pinkish white with darker pinkish red edges. *Stipe* 11-22  $\times$  0.1-0.2 mm, cylindrical, equal, tough, terete, dry, dull, glabrous, non-insititious, pale red

(12A3) at the apex, dark brown at the base, with white basal mycelium.

*Basidiospores* 18.5-23 (-25)  $\times$  3.5-5 (-6)  $\mu$ m [ $x_m = 21.4 \pm 1.5 \times 4 \pm 0.6 \mu$ m,  $Q = 4-7.2$ ,  $Q_m = 5.5 \pm 0.7$ ,  $n = 40$ ], elongate-lacrymoid to fusoid, hyaline, smooth, inamyloid. *Basidia* not observed. *Basidioles* 23-30  $\times$  6-7  $\mu$ m, clavate to fusoid. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (5-) 10-25  $\times$  5-10 (-11)  $\mu$ m, clavate to broadly clavate, hyaline, inamyloid, thick-walled; apical setulae 3-6  $\times$  0.5  $\mu$ m, crowded, cylindrical to conical, subacute to obtuse, seldom branched or forked, light yellow, inamyloid, thin-walled. *Pleurocystidia* scattered, 37-42  $\times$  9-12  $\mu$ m, fusoid to clavate with a constricted mucro, refractive, yellow, inamyloid, thin-walled. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 7-17 (-20)  $\times$  6-10 (-13)  $\mu$ m, cylindrical to clavate or subclavate, seldom lobed, hyaline, weakly dextrinoid,



thick-walled; apical setulae  $3.5-6$  ( $-7$ )  $\times$   $0.5-1$   $\mu\text{m}$ , crowded, cylindrical to conical, acute to subacute, rarely forked, light brownish yellow to tawny, weakly dextrinoid, thick-walled. *Pileus trama* subparallel; hyphae  $4-5$   $\mu\text{m}$  diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae  $3-5$   $\mu\text{m}$  diam, cylindrical, hyaline, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae  $4.5-6$   $\mu\text{m}$  diam, parallel, cylindrical, smooth, dark brownish yellow, very weakly dextrinoid, thick-walled ( $1-2$   $\mu\text{m}$  thick), non-gelatinous; medullary hyphae  $5-6$   $\mu\text{m}$  diam, parallel, cylindrical, smooth, hyaline to light yellow, dextrinoid, thin-walled ( $0.5-1$   $\mu\text{m}$ ), non-gelatinous. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves in montane forest. Malaysia (Selangor).

*Material examined:* Malaysia, Selangor, Pangsun, Mount Nuang Forest Reserve, N  $03^{\circ} 12.593'$ , E  $101^{\circ} 52.575'$ , 319 m, 17 May 2005, Yee-Shin Tan, TYS 478 (**Holotype:** KLU-M#72, **Isotype:** SFSU).

*Notes:* *Marasmius distantifolius* is characterized by the following features: a small ( $2-8$  mm diam), sulcate, papillate, convex-umbonate to broadly convex-depressed pileus coloured deep brownish red to brownish violet or greyish red (not violet); distant ( $7-9$ ), pinkish white lamellae with darker pinkish red edges; a glabrous stipe  $11-22 \times 0.5$  mm coloured pale red at the apex and dark brown at the base with white basal mycelium; basidiospores in the range  $18.5-25 \times 3.5-5$   $\mu\text{m}$  with mean  $21.4 \times 4$   $\mu\text{m}$ ; small, broadly clavate (not strangulate) pleurocystidia in the range  $37-42 \times 9-12$   $\mu\text{m}$ ; *Siccus*-type cheilocystidia and pileipellis broom cells with narrowly conical, acute setulae  $3-6$   $\mu\text{m}$  long; and growth on leaves. It is similar to Old World populations of *M. haematocephalus* (Mont.) Fr. but the latter differs in forming more violet pigmented pilei, more lamellae ( $10-18$ ), and slightly shorter basidiospores with mean length in the range  $18-21$   $\mu\text{m}$  (see below; Desjardin & Horak, 1997; Desjardin *et al.*, 2000). The two species are sister taxa in the ITS phylogeny with strong support (100% BS, 1.0 PP), although they are on long branches relative to each other and to other species in the tree.

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

(Fig. 52, Plate 3E)

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

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

Taxonomic synonyms:

= *Marasmius rhodocephalus* Fr., Nova Acta Regiae Soc. Sci. Uppsal. 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.

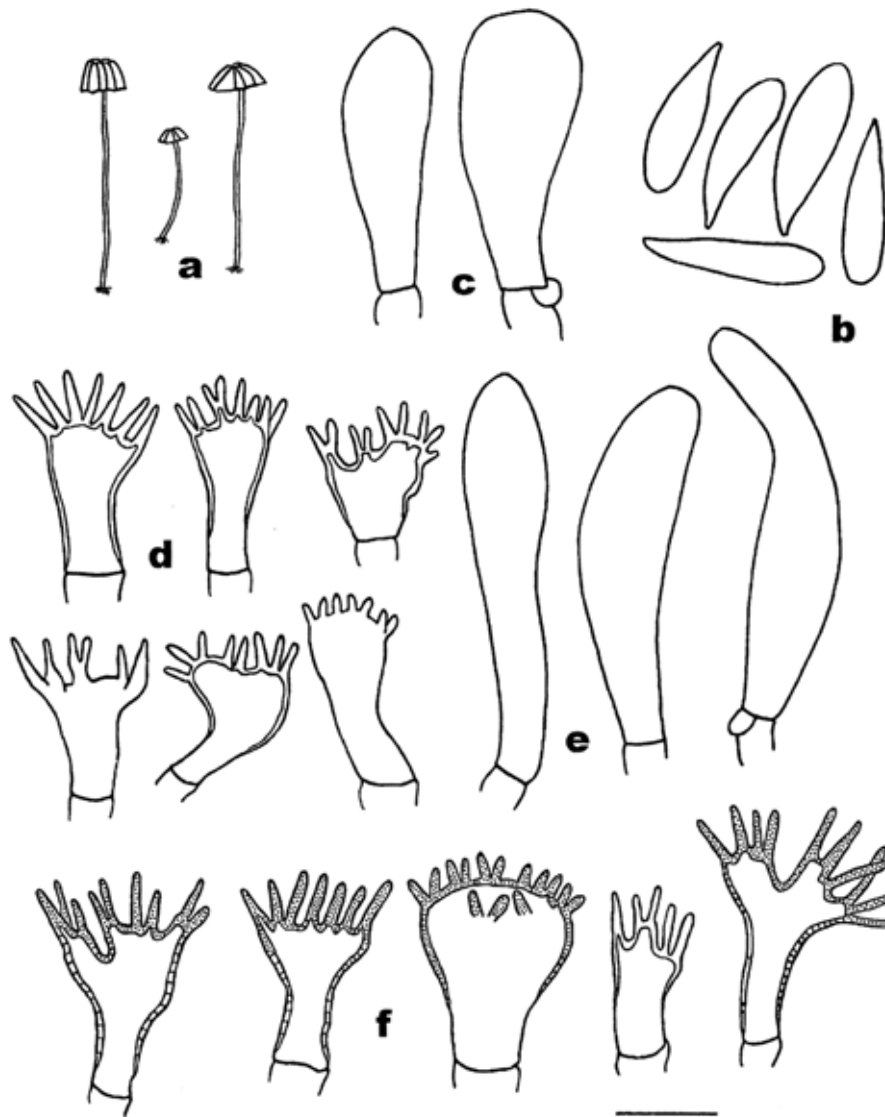
= *Marasmius atropurpureus* Murrill, N. Amer. Fl. 9: 262. 1915.

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

Type: Brazil, Rio de Janeiro, A. de Saint Hilaire. Not extant.

*Pileus*  $2-7$  mm in diam, obtusely conical to convex with a small central papilla; margin striate; surface dry, dull, minutely velutinous; dark purple ( $14F7-8$ ) to dark violet ( $15F7-8$ ). *Lamellae* adnate, subdistant ( $12-13$ ) with no lamellulae, pinkish white ( $11A2$ ) to pale red ( $11A3$ ), non-marginate. *Stipe*  $8-23 \times 0.5-1$  mm, central, cylindrical, twisted-fibrous, dry, dull, glabrous, non-insititious, dark brown overall, arising from white basal mycelium.

*Basidiospores* ( $15-$ )  $17-20$  ( $-23$ )  $\times$   $3.5-4.5$   $\mu\text{m}$  [ $x = 18.2 \pm 1.6 \times 3.8 \pm 0.5$   $\mu\text{m}$ ,  $Q = 4-5.3$ ,  $Q_m = 4.8 \pm 0.6$ ,  $n = 40$  spores], elongate-lacrymoid to fusoid or clavate, smooth, hyaline, inamyloid. *Basidia* not observed. *Basidioles*  $17-28 \times 8-12.5$   $\mu\text{m}$ , fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body  $8-21 \times (5-)$   $7-10$   $\mu\text{m}$ , subcylindrical to clavate or broadly clavate, hyaline, inamyloid, thin- to thick-walled; apical setulae  $2-6 \times 0.5-2$   $\mu\text{m}$ , crowded, cylindrical to conical, subacute to obtuse, hyaline to light yellow, thin- to thick-walled. *Pleurocystidia* scattered,  $30-42 \times 7-10$   $\mu\text{m}$ , fusoid to clavate, seldom with a constricted mucro, non-refractive or refractive, hyaline, inamyloid, thin-walled, arising from the lamellar trama and projecting up to  $13$   $\mu\text{m}$  beyond basidioles. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body  $9-20 \times 5-13$   $\mu\text{m}$ , subcylindrical to clavate or broadly clavate, hyaline to yellowish brown,



**Fig. 52.** *Marasmius haematocephalus* (TYS 523 = KLU-M#8). a. Basidiomes. b. Basidiospores. c. Basidioles. d. Cheilocystidia. e. Pleurocystidia. f. Pileipellis. Bars: a = 10, b-f = 10  $\mu\text{m}$ .

inamyloid, thin- to thick-walled; apical setulae  $3-8 \times 0.5-1 \mu\text{m}$ , cylindrical to conical, acute or subacute, tawny to reddish brown, dextrinoid, thick-walled. *Pileus trama* interwoven; hyphae  $3-4 \mu\text{m}$  diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular; hyphae  $3-5 \mu\text{m}$  diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae  $3-5 \mu\text{m}$  diam, parallel, cylindrical, smooth, dark brown, dextrinoid, thick-walled; medullary hyphae  $4-6 \mu\text{m}$  diam, parallel, cylindrical, smooth, hyaline, dextrinoid to strongly dextrinoid, thin-walled. *Caulocystidia* absent. *Clamp connections* present.

*Habit, habitat and known distribution:* gregarious on undetermined dicotyledonous leaves. Putatively pantropical; Africa, Asia,

North, Central and South America, Malaysia (Selangor), New Zealand, Papua New Guinea.

*Material examined:* Malaysia, Selangor, Ulu Gombak, University of Malaya's Field Study Center, 5 Sept. 2005, Yee-Shin Tan, TYS 523 (KLU-M #8, SFSU).

*Notes:* This is the purple form of *M. haematocephalus* that is widespread in the Old World tropics. The Malaysian material matches that described from Sri Lanka (Pegler, 1986), Papua New Guinea (Desjardin & Horak, 1997) and Indonesia (Desjardin *et al.*, 2000), although the Malaysian population forms less constricted pleurocystidia. Basidiospore size in this species is apparently variable, with populations in Sri Lanka having a spore mean of  $14 \times 3.7 \mu\text{m}$ , in Malaysia and Papua New Guinea the spore mean is  $18.2 \times 3.8 \mu\text{m}$ , whereas in Indonesia (Java) they measure  $20.5 \times 4.0 \mu\text{m}$ .

The mating system of New World (Puerto Rico) specimens of *M. haematocephalus* was reported as bipolar (specimen TENN 50917), secondary homothallic (TENN 50916; 12 of 12 ssi were dikaryotic) and amphithallic/bipolar (TENN 50918; 7 of 12 ssi were dikaryotic) by Gordon *et al.* (1994). Although no single-spore isolates (ssi) of the Malaysian specimen germinated to form dikaryotic hyphae (and hence the specimen is not amphithallic), the report of a bipolar mating system for a Malaysian population of *M. haematocephalus* (Tan *et al.* 2007) is consistent with that of New World populations.

## Conclusions

A total of 43 species of *Marasmius sensu stricto* are reported from Malaysia, including two species (*M. corneri* and *M. abundans* var. *campanulatus*) that have not yet been collected in Malaysia but are expected to occur. Out of the 41 species that have been collected, 19 species are documented as new records in Malaysia, while 9 species are described herein as new to science (viz., *M. angustilamellatus*, *M. diminutivus*, *M. distantifolius*, *M. iras*, *M. kanchingensis*, *M. kuthubtheenii*, *M. musicolor*, *M. ochropoides*, and *M. olivascens*). Three additional species from Malaysia were previously described by us as new to science, viz., *M. acerosus*, *M. nummularioides* and *M. selangorensis* (Tan *et al.*, 2007). The 43 morphological species reported herein belong to six sections of *Marasmius* as defined by suites of morphological characters (sections *Sicci*, *Globulares*, *Marasmius*, *Hygrometrici*, *Neosessiles* and *Leveilleani*). Of the 121 species of *Marasmius sensu lato* reported from Malesia by Corner (1996), type studies revealed that only 20 of these species belong to *Marasmius sensu stricto*. The other 101 species belong to numerous other genera.

The ITS sequences supported species concepts based on shared morphological features where nearly all morphospecies were clustered in well-resolved clades. The ITS derived phylogeny was unable to resolve currently accepted infrageneric taxa as monophyletic groups, with the exception of sect. *Marasmius* subsect. *Marasmius* which was monophyletic with 96% BS and 1.0 PP

support. The inclusion of additional taxa and additional genes are necessary to clarify the infrageneric delimitation of *Marasmius sensu stricto*. The ITS sequence data supported the use of selected micromorphological features, such as basidiospore size, cystidium-type, and pileipellis anatomy, in delimiting species and clusters of closely related species.

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