
New species and mating studies of *Marasmius* from Malaysia

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The mating systems operating in ten species of *Marasmius* collected recently in Malaysia are reported. In addition, three species belonging to section *Sicci* are described as new, viz., *Marasmius acerosus*, *M. nummulariodes* and *M. selangorensis*. Of the ten species analyzed six members of sect. *Sicci* were bipolar (*M. abundans* var. *aurantiacus*, *M. acerosus*, *M. haematocephalus*, *M. luteomarginatus*, *M. nummulariodes*, *M. selangorensis*), whereas four members of sect. *Marasmius* were tetrapolar (*M. berambutanus*, *M. brevicollis*, *M. gracilichorda*, *M. tubulatus*). This section-specific pattern of mating systems operating in tropical Asian species of *Marasmius* is concordant with that reported from temperate North American and European species. This paper represents the first report of mating system data from tropical Asian *Marasmius* species, and reports the second known collection of *M. luteomarginatus* and presents new distribution records for most species included.

Key words: bifactorial, bipolar, taxonomy, tetrapolar, unifactorial

Introduction

There has been renewed interest in the genus *Marasmius* (Antonín, 2003, 2004a,b; Wannathes *et al.*, 2004; Antonin and Buyck, 2006; Desjardin and Ovrebo, 2006). The diversity of macrofungi in Malaysia is poorly known. Chipps (1921) was the first to report on Malayan fungi, wherein he documented 11 species of *Marasmius* collected in Malaysia and Singapore. Many of these species are vouchered only by colored sketches of the fresh material painted on site by the collectors. More recently, Corner (1996) published a preliminary accounting of Malesian *Marasmius sensu lato* in which he reported 121 species (of which 103 represented new species) from Singapore, Malaysia, Borneo and the Solomon Islands. In addition, Wannathes

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et al. (2004) report *M. pellucidus* Berk. & Broome as a species with widespread distribution throughout Malesia. Corner accepted a much broader generic concept of *Marasmius* than most contemporary workers, and included taxa that we accept in *Gymnopus*, *Hemimycena*, *Marasmiellus*, *Moniliophthora*, *Rhodocollybia*, *Setulipes* and *Tetrapyrgos*. During the course of re-evaluating Corner's (1996) Malesian *Marasmius* specimens and developing a comprehensive monograph of Malaysian *Marasmius sensu stricto*, we have encountered numerous new species of which three are described formally herein.

Several different types of mating systems have been reported from temperate species of *Marasmius*, where they are apparently consistent within infrageneric taxa. Members of sections *Sicci* and *Globulares* have been reported as bipolar (unifactorial) or amphithallic (overlying bipolar) by Vandendries (1936), Burnett and Evans (1966), Mallet and Harrison (1988), Gordon and Petersen (1991), Desjardin *et al.* (1992), and Gordon *et al.* (1994). In comparison, members of sections *Marasmius*, *Epiphylli*, *Androsaceus* (= genus *Setulipes*) and *Alliacei* (= genus *Mycetinis*) have been reported as tetrapolar (bifactorial) by Yen (1950), Terra (1953), Lamoure (1989), Gordon and Petersen (1991), Holmer and Stenlid (1991), Gordon *et al.* (1994), and Petersen (1997). To date, no reports of the mating systems operating in tropical Asian species of *Marasmius* have been reported. To test whether there is phylogenetic significance to the type of mating system operating in Asian *Marasmius s.s.*, and to test whether the section-specific pattern of mating system type reported from temperate North American and European species holds true for tropical Asian species of *Marasmius*, we analyzed the mating systems of ten species of *Marasmius* collected recently in Malaysia.

Materials and Methods

Morphological studies

Samples were collected in numerous primary forests in Peninsular Malaysia. Dried collections were accessioned into the Herbarium of University of Malaya (KLU) at the University of Malaya, Kuala Lumpur, with duplicates deposited in the Harry D. Thiers Herbarium (SFSU) at San Francisco State University. Macro- and micromorphological terminology used for descriptions follow Largent (1986) and Largent *et al.* (1977). Color terms and notations in parentheses are from Kornerup and Wanscher (1978). Dried samples were sectioned and rehydrated in 95% ethanol, followed by 3% potassium hydroxide (KOH) or Melzer's reagent. Sections were observed using a Nikon Alphaphot-2 microscope with drawing tube. The terms used to describe lamellae spacing

refer to the number of lamellae that reach from the stipe to the pileus margin and do not include the lamellulae, whose spacing is indicated by the number of series present. Spore statistics include: \bar{x} , 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) where 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.

Mating studies: self-cross experiments

Single-spore isolation and self-crosses follow the techniques described by Gordon and Peterson (1991). All cultures are maintained on potato dextrose agar (Difco). Under individual taxa, tester strains are denoted by an asterisk (*) next to the strain number. Tester strains are deposited in the Mycology Lab at the University of Malaya, Kuala Lumpur.

Results

The mating systems operating in ten species of *Marasmius* from Malaysia were determined. Six species belonging to sect. *Sicci* exhibit a bipolar (unifactorial) mating system, while four species belonging to sect. *Marasmius* exhibit a tetrapolar (bifactorial) mating system. Of these ten species, three are new to science and described herein (all in sect. *Sicci*), four represent new records for Malaysia, and three are new reports of species recently described from Malaysia by Corner (1996). Descriptions, illustrations and mating system data for all ten species are presented below.

Taxonomy

Marasmius section *Sicci* Singer

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

Marasmius abundans* var. *aurantiacus Corner, Beih. Nova Hedwigia 111: 23. 1996. (Fig. 1)

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

Pileus 3-20 mm diam, paraboloid to broadly obtusely conical or broadly convex; surface dry, dull, hygrophanous, minutely velutinous; margin smooth

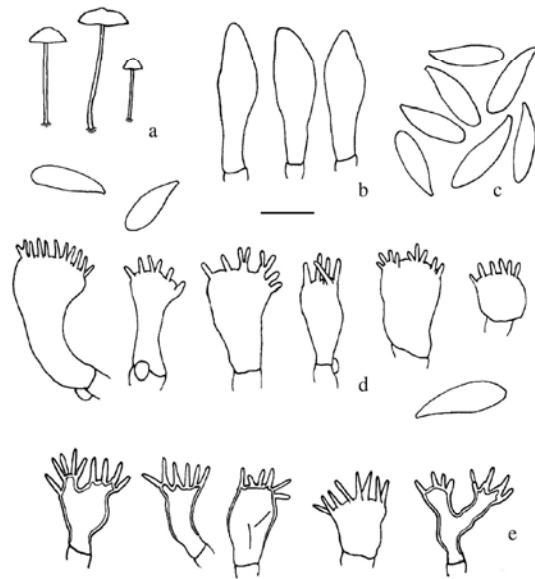


Fig. 1. *Marasmius abundans* var. *aurantiacus* Corner (TYS 515). **a.** Basidiomes. **b.** Basidiospores. **c.** Basidioles. **d.** Cheilocystidia. **e.** Pileipellis. Bars: a = 10 mm, b-e = 10 μ m.

(non-striate); orange (5A6, 6B7) with deep orange around the disc when young, becoming deep orange (6A8) overall at maturity. *Lamellae* adnate, close (15-18) with 3-4 series of lamellulae, orangish-white, non-marginate. *Stipe* 13-38 \times 0.5 mm, central, cylindrical, terete, equal, dry, dull, glabrous, non-insititious, base covered with brownish-orange mycelium; yellowish-white at apex, gradually changing to orange, brownish-orange, light brown or reddish-brown on the base.

Basidiospores (11-) 13-16 (-17) \times 4-5 μ m [\bar{x} = 14.3 \pm 1.3 \times 4.4 \pm 0.3 μ m, Q = 2.9-4, Q_m = 3.3 \pm 0.4, n = 22 spores], elongate-lacrimoid to clavate, smooth, hyaline, inamyloid. *Basidia* not observed. *Basidioles* 23-26 \times 6-8 μ m, fusoid to clavate. *Cheilocystidia* numerous, lamellar edge sterile, composed of *Siccus*-type broom cells; main body (9-) 13-23 \times 5-11 μ m, cylindrical to clavate or broadly clavate, hyaline, inamyloid, thin-walled; apical setulae 2-6.5 \times 0.5-1 μ 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 8-17 \times 5-13 μ m, cylindrical to clavate or sub-globose, hyaline, inamyloid, thick-walled; apical setulae 3-7 \times 0.5-1 μ m, cylindrical to conical, light yellow to tawny, weakly dextrinoid, thick-walled. *Pileus trama* interwoven, hyphae 4-7 μ m diam, cylindrical, hyaline, strongly dextrinoid, thin-walled, non-gelatinous.

Lamellar trama regular, hyphae 3-6 μm diam, cylindrical, hyaline, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-6 μm 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 distribution: gregarious on undetermined dicotyledonous leaves. Johor, Malaysia.

Material examined: MALAYSIA, Johor, Endau Rompin National Park, NERC, Peta Village, on way to jetty, 14 July 2005, Yee-Shin Tan, TYS 515 (KLU-M #1, SFSU).

Mating system: TYS 515 = Bipolar (unifactorial). See Table 1.

Isolate mating type assignment: A₁: 3, 4, 5, 13, 14, 16*, 17, 21, 27; A₂: 7, 9*, 12, 19, 20, 26.

Notes. Our specimen matches quite closely to Corner's protologue (1996), differing only in basidiospore size. Collection TYS 515 has spores ranging from 13-16 \times 4-5 μm with mean 14.3 \times 4.4 μm , whereas the protologue documents smaller basidiospores in the range 11-13 \times 3.5-4 μm . 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 μm (Pegler, 1986).

Table 1. Self-crosses between 15 single spore isolates of *Marasmius abundans* var. *aurantiacus* (TYS 515). + = presence of clamp connection; - = absence of clamp connection; NA = not available (contaminated or no growth).

	A ₁									A ₂					
	3	4	5	13	14	16*	17	21	27	7	9*	12	19	20	26
3	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+
4	-	-	-	-	-	-	NA	-	-	+	+	+	+	+	+
5	-	-	-	-	-	-	-	-	-	NA	+	+	NA	+	+
13	-	-	-	-	NA	NA	-	-	-	+	+	+	+	+	+
14	-	-	-	NA	-	-	-	-	-	+	+	+	NA	+	+
16	-	-	-	NA	-	-	-	-	-	+	+	+	+	+	+
17	-	NA	-	-	-	-	-	-	-	NA	+	+	-	+	+
21	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+
27	-	-	-	-	-	-	-	-	-	+	+	+	-	+	+
7	+	+	NA	+	+	+	NA	+	+	-	-	-	-	-	-
9	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
12	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
19	+	+	NA	+	NA	+	-	+	-	-	-	-	-	-	-
20	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
26	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-

***Marasmius acerosus* Y.S. Tan & Desjardin, sp. nov.**

(Fig. 2)

MycoBank: 510519.

Pileus 4-15 mm latus, late convexus, striatulus, griseoluteus vel aurantio-brunneus. *Lamellae* adnatae, densae (16-25), pallide stramineae, haud marginatae. *Stipes* 15-34 × 0.5 mm, teres, aequalis, glabrus, haud insititus, apicaliter stramineus, basim versus aurantio-brunneus, ad basim tomento aurantiacus strigosoque affixus. *Basidiosporae* 13-15 × 4-4.5 μm, clavatae, leves, hyalinae, inamyloideae. *Basidiola* clavata vel fusoidea. *Cheilocystidia* typi Sicci, cellulae 12-24 × 6-10 μm, setulosae, cylindricae vel clavatae, hyalinae, crasse-tunicatae, setulae ad apicem 2-10 × 0.5-1 μm, densae, conicae vel acerosae, subacutae vel acutae, stramineae. *Pleurocystidia* nulla. *Pileipellis* hymeniformis, cellulae typi Sicci 10-25 × 6-13 μm, setulosae, clavatae vel irregulares, stramineae, inamyloideae, crasse-tunicatae, setulae ad apicem 6-13 × 0.5-1 μm, densae, acerosae, stramineae vel brunneae, crasse-tunicatae. *Trama pilei* irregulare, trama lamellarum regulare, hyphis dextrinoideis instructum. *Caulocystidia* nulla. *Fibulae* presentes. Gregarius, ad folia putrida plantarum dicotyledonearum. **Holotypus** hic designatus: Malaysia, Selangor, Sungai Chongkak Forest Reserve, 16 May 2005, Y.S. Tan #458 (**holotypus** KLU-M #2; **isotypus** SFSU).

Pileus 4-15 mm diam, conical to convex with a small umbo when young, becoming broadly convex to plano-convex in age; surface dry, dull, glabrous; margin smooth to weakly striatulate in age; grayish-yellow (4B4) with brownish-orange (5C6) disc when young, in age becoming grayish-yellow

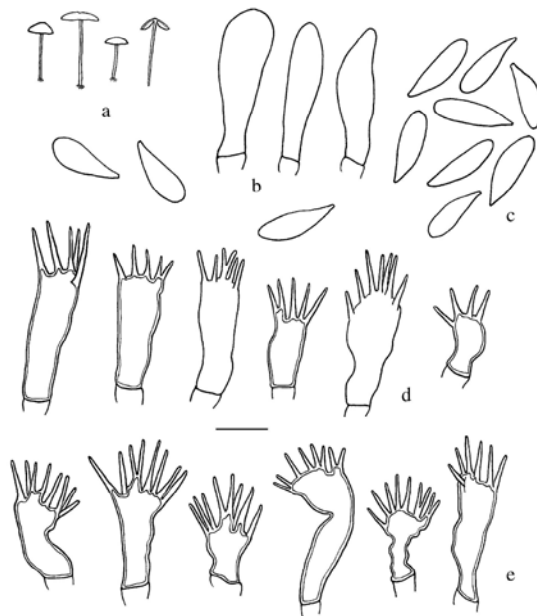


Fig. 2. *Marasmius acerosus* (TYS 458, holotype). **a.** Basidiomes. **b.** Basidioles. **c.** Basidiospores. **d.** Cheilocystidia. **e.** Pileipellis. Bars: a = 10 mm, b-e = 10 μm.

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

Basidiospores 13-15 (-15.5) × 4-4.5 (-5) μm [\bar{x} = 14.4 ± 0.8 × 4.4 ± 0.3 μm, Q = 2.9-3.8, Q_m = 3.3 ± 0.2, n = 20 spores], elongate-lacrimoid to clavate, smooth, hyaline, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* 23-36 × 6-8 μm, 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 × 6-10 μm, cylindrical to clavate or broadly clavate to irregular in outline, rarely lobed, hyaline, inamyloid, thick-walled; apical setulae 2-10 × 0.5-1 μm, 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 × 6-13 μm, cylindrical to clavate, broadly clavate or irregular in outline, rarely lobed, light yellow, inamyloid, thick-walled; apical setulae 6-13 × 0.5-1 μm, conical to acerose, rarely forked, acute, yellow to yellowish-brown, inamyloid, thick-walled. *Pileus trama* interwoven, hyphae 4-9 μm diam, cylindrical, hyaline, weakly dextrinoid to dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular, hyphae 3.5-5 μm diam, cylindrical, hyaline, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4.5-6 μm diam, parallel, cylindrical, smooth, yellow (apex) to brownish-yellow (base), inamyloid to weakly dextrinoid, thick-walled (-1 μm), non-gelatinous; medullary hyphae 5-9 μm, parallel, cylindrical, smooth, hyaline to light yellow, dextrinoid, thin-walled. *Caulocystidia* absent. *Clamp connections* present.

Habit, habitat and distribution: gregarious on undetermined dicotyledonous leaves and twigs. Selangor, Malaysia.

Material examined: MALAYSIA, Selangor, Sungai Chongkak Forest Reserve, 16 May 2005, Yee-Shin Tan, TYS 458 (**holotype:** KLU-M #2; **isotype:** SFSU).

Etymology: acerosus (L.) = needle-shaped, referring to the setulae on broom cells.

Mating system: TYS 458 = Bipolar (unifactorial). See Table 2.

Isolate mating type assignment: A₁: 4, 6, 8*, 13, 20, 21, 23, 24, 26; A₂: 16, 28*, 31.

Notes. *Marasmius acerosus* is characterized by the following features: a smooth to weakly striatulate pileus colored 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 $13-15 \times 4-4.5 \mu\text{m}$ ($\bar{x} = 14.4 \times 4.4 \mu\text{m}$); *Siccus*-type cheilocystidia and pileipellis broom cells with needle-like setulae up to $10 \mu\text{m}$ 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 15-18), smaller basidiospores ($10-13 \times 3-4 \mu\text{m}$), and cheilocystidia with cylindrical to subconical, obtuse setulae only up to $7 \mu\text{m}$ long (Corner, 1996; type studies and this paper). *Marasmius berteroi* differs in forming plicate pilei, sub-distant lamellae (11-16), and cheilocystidia with obtuse to subacute setulae up to $5 \mu\text{m}$ long (Desjardin *et al.*, 2000).

Table 2. Self-crosses between 12 single spore isolates of *Marasmius acerosus* (TYS 458). + = presence of clamp connection; - = absence of clamp connection; NA = not available (contaminated or no growth).

	4	6	8*	13	A ₁				A ₂			
					20	21	23	24	26	16	28*	31
4		-	-	-	-	-	-	-	-	+	+	+
6	-		-	-	-	-	NA	-	-	+	+	+
8	-	-		-	-	-	-	-	-	+	+	+
13	-	-	-		-	-	-	-	-	+	+	+
20	-	-	-	-		-	-	-	-	+	+	+
21	-	-	-	-	-		-	-	-	+	+	+
23	-	NA	-	-	-	-		-	-	+	+	+
24	-	-	-	-	-	-	-		-	NA	+	+
26	-	-	-	-	-	-	-	-		+	+	NA
16	+	+	+	+	+	+	+	NA	+		-	-
28	+	+	+	+	+	+	+	+	+	-		NA
31	+	+	+	+	+	+	+	+	NA	-	NA	

Marasmius luteomarginatus Desjardin, Retnowati & E. Horak, Sydowia. 52: 166. 2000. (Fig. 3)

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; surface dry, dull, minutely velutinous; margin striate to sulcate; 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 \times 1 mm, mostly eccentric when young, in age central, cylindrical, terete, equal, dry, dull, glabrous, non-insititious, base with grayish-orange tomentum; orangish-white at apex, brownish-orange (6C7-8) at the base.

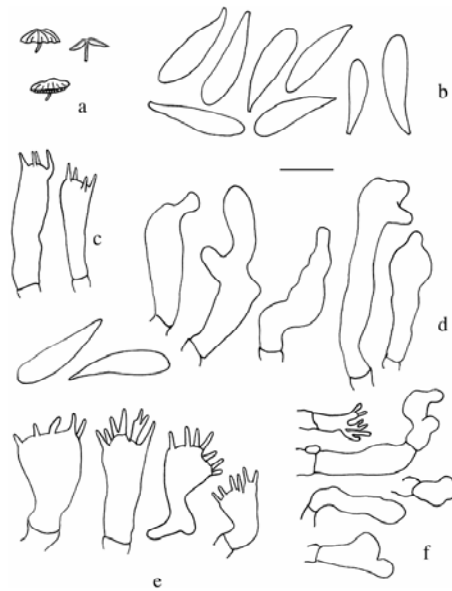


Fig. 3. *Marasmius luteomarginatus* (TYS 477). **a.** Basidiomes. **b.** Basidiospores. **c.** Basidia. **d.** Cheilocystidia. **e.** Pileipellis. **f.** Caulocystidia. Bars: a = 10 mm, b-f = 10 µm.

Basidiospores (14-) 16-20 × (3.5-) 4-5 µm [\bar{x} = 17.9 ± 1.8 × 4.2 ± 0.4 µm, Q = 3.5-5.1, Q_m = 4.1 ± 0.9, n = 28 spores], elongate-lacrimoid 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 mottled to mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 8-20 × 8-10 (-13) µm, 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 × 0.5-1 µm, cylindrical to conical, rarely forked, yellow, weakly dextrinoid, thick-walled. *Pileus trama* subparallel, hyphae 4-6 µm diam, cylindrical, hyaline, dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular, hyphae 4-5 µm diam, cylindrical, hyaline to light yellow, weakly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-6.5 µm diam, parallel, cylindrical, smooth, light yellow to light brown, weakly dextrinoid to dextrinoid, thick-walled (-1 µm); medullary hyphae 3-4 µm 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 × 5-7 µm, cylindrical to conical,

hyaline, inamyloid, thin-walled; apical setulae $2-3 \times 1 \mu\text{m}$, narrowly cylindrical to clavate, obtuse to subacute, hyaline, inamyloid, thin-walled; b) non-setulose cells like the cheilocystidia, $12-22 \times 3.2-6.5 \mu\text{m}$, clavate, hyaline, inamyloid, thin-walled. *Clamp connections* present.

Habit, habitat and distribution: gregarious on leaves of palm. Selangor, Malaysia.

Material examined: MALAYSIA, Selangor, Pangsun, Gunung Nuang Forest Reserve, 17 May 2005, Yee-Shin Tan, TYS 477 (KLU-M #3, SFSU).

Mating system: TYS 477 = Bipolar (unifactorial). See Table 3.

Isolate mating type assignment: A₁: 1, 3*, 4, 5, 10, 11, 12, 15, 16, 19, 31; A₂: 8, 14, 17, 22, 27*, 28, 29, 33.

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.

Table 3. Self-crosses between 19 single spore isolates of *Marasmius luteomarginatus* (TYS 477). + = presence of clamp connection; - = absence of clamp connection; NA = not available (contaminated or no growth).

	A ₁										A ₂								
	1	3*	4	5	10	11	12	15	16	19	31	8	14	17	22	27*	28	29	33
1	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+
3	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+
4	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+
5	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+
10	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+
11	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+
12	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+
15	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+
16	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+
19	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	NA	+
31	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+
8	+	-	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
14	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
17	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
22	+	+	+	+	+	+	-	+	+	+	+	-	-	-	-	-	-	-	-
27	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
28	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
29	+	+	+	+	+	+	+	+	+	NA	+	-	-	-	-	-	-	-	-
33	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-

Marasmius selangorensis Y.S.Tan & Desjardin, **sp. nov.**

(Fig. 4)

MycoBank: 510520.

Pileus 10-23 mm diam, parabolicus vel late convexus, umbonatus, sulcatus vel plicatus, minutae velutinus, rugulosus ad centrum, brunneus vel atrobrunneus dein pallide brunneus vel

subroseibrunneus. *Lamellae* adnatae, distantes (12-18), angustatae, brunneomarginatae. *Stipes* 19-43 × 0.5-1 mm, teres, aequalis, glabrus, haud insititius, primo apicaliter stramineus et basim aurantiacus, dein basim brunneus vel atrobrunneus, ad basim tomento stramineus strigosoque affixus. *Basidiosporae* 18-24 × 4-5 μm, clavatae vel fusoideae, leves, hyalinae, inamyloideae. *Basidiola* clavata vel fusoidea. *Cheilocystidia* typi Sicci, cellulae 10-16 (-20) × 6-10 (-13) μm, setulosae, clavatae vel irregulares, hyalinae, crasse-tunicatae, setulae ad apicem 4-12 × 1-2 μm, densae, cylindricae vel conicae, subacutae vel obtusae, luteae vel pallide brunneae, crasse-tunicatae. *Pleurocystidia* nulla. *Pileipellis* hymeniformis, cellulae typi Sicci 7-20 × 5-8 μm, setulosae, clavatae vel cylindricae, stramineae, inamyloideae, crasse-tunicatae, setulae ad apicem 7-15 × 1-4 μm, cylindricae vel conicae, stramineae vel brunneae, crasse-tunicatae. *Trama pilei* irregulare, trama lamellarum regulare, hyphis dextrinoideis instructum. *Caulocystidia* nulla. *Fibulae* presentes. Gregarius, ad folia putrida plantarum dicotyledonearum. **Holotypus** hic designatus: Malaysia, Selangor, Hulu Langat, Sungai Chongkak Forest Reserve, 15 May 2005, Y.S. Tan #453 (**holotypus** KLU-M #4; **isotypus** SFSU).

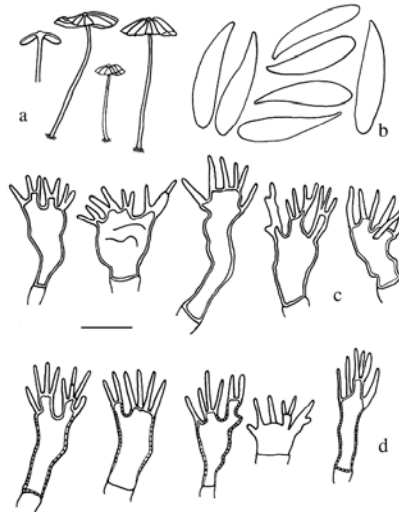


Fig. 4. *Marasmius selangorensis* (TYS 453, holotype). **a.** Basidiomes. **b.** Basidiospores. **c.** Cheilocystidia. **d.** Pileipellis. Bars: a = 10 mm, b-d = 10 μm.

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) 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. *Odor* pleasant. *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.

Basidiospores (17-) 18-24 (-25) × (3.5-) 4-5 μm [$x_{mr} = 19.2-21.3 \times 4-4.3$ μm, $x_{mm} = 20.9 \pm 1.0 \times 4.1 \pm 0.2$ μm, 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, inamyloid, thin-walled. *Basidia* not observed. *Basidioles* 22-30 × 6-8 μm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body (7-) 10-16 (-20) × 6-10 (-13) μm, subcylindrical to clavate, broadly clavate or irregular in outline, seldom lobed, hyaline, inamyloid, thick-walled; apical setulae 4-12 × 1-2 μm, 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 × 5-8 μm, cylindrical to clavate or subclavate, sometimes lobed, light yellow, inamyloid, thick-walled; apical setulae 7-15 × 1-4 μm, cylindrical to conical, rarely forked, yellow to brownish-yellow or brown, inamyloid, thick-walled. *Pileus trama* interwoven, hyphae 4-8 μm diam, hyaline, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Lamellar trama* regular, hyphae 4-8 μm diam, cylindrical, hyaline to light yellow, dextrinoid to strongly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 3-9 μm diam, parallel, cylindrical, smooth, yellow at apex, brownish-yellow at base, weakly dextrinoid to dextrinoid, thick-walled (0.5-1 μm); medullary hyphae 4-10 μm diam, parallel, cylindrical, smooth, light yellow, dextrinoid, thin-walled or with walls up to 0.5 μm thick. *Caulocystidia* absent. *Clamp connections* present.

Habit, habitat and distribution: gregarious on undetermined dicotyledonous leaves. Selangor, Malaysia.

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).

Etymology: Selangor (Malaysian) = the province of Malaysia from which the species is known.

Mating system: TYS 453 = Bipolar (unifactorial). See Table 4.

Isolate mating type assignment: A₁: 5, 12*, 20, 29, 31, 33; A₂: 4, 6, 7, 8, 19*, 21, 30, 32.

Notes. The species 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 × 4-5 μm ($\bar{x} = 21 \times$

4 μm); *Siccus*-type cheilocystidia and pileipellis broom cells with setulae up to 12 μm long; an absence of pleurocystidia and caulocystidia; and growth on dicotyledonous leaves. *Marasmius selangorensis* is allied with *M. adhaesus* Corner and *M. aciebrunneus* Corner 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, grayish-olive) and has longer basidiospores in the range $25\text{-}30 \times 4.5\text{-}5 \mu\text{m}$ (Corner, 1996; E!). *Marasmius aciebrunneus* differs primarily in forming pilei with ferruginous or orange and yellow colors, and has slightly longer basidiospores ($22\text{-}26 \times 4\text{-}5 \mu\text{m}$; Corner, 1996; E!). *Marasmius sierraleonis* differs in forming dull yellow to rusty-brown pilei, has a longer stipe (35-70 mm), smaller basidiospores ($15.5\text{-}20 \times 3.5\text{-}4.7 \mu\text{m}$, $\bar{x} = 17.5 \times 4 \mu\text{m}$) and in growth on twigs (Pegler, 1977). *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 ($16\text{-}23.5 \times 2.3\text{-}3.7 \mu\text{m}$, $\bar{x} = 17 \times 3 \mu\text{m}$; Singer, 1965; Pegler, 1977).

Table 4. Self-crosses between 14 single spore isolates of *Marasmius selangorensis* (TYS 453). + = presence of clamp connection; - = absence of clamp connection; NA = not available (contaminated or no growth).

	A ₁							A ₂						
	5	12*	20	29	31	33	4	6	7	8	19*	21	30	32
5	-	-	-	-	-	-	+	+	+	+	+	+	+	+
12	-	-	-	-	-	-	+	+	+	+	+	+	+	+
20	-	-	-	-	-	-	+	+	+	+	+	+	+	+
29	-	-	-	-	-	-	+	+	+	+	+	+	+	+
31	-	-	-	-	-	-	+	+	+	+	+	+	+	+
33	-	-	-	-	-	-	+	+	+	+	+	+	+	+
4	+	+	+	+	+	+	-	-	-	-	-	-	-	-
6	+	+	+	+	+	+	-	-	-	-	-	-	-	-
7	+	+	+	+	+	+	-	-	-	-	-	-	NA	-
8	+	+	+	+	+	+	-	-	-	-	-	-	-	-
19	+	+	+	+	+	+	-	-	-	-	-	-	-	-
21	+	+	+	+	+	+	-	-	-	-	-	-	-	-
30	+	+	+	+	+	+	-	-	NA	-	-	-	-	-
32	+	+	+	+	+	+	-	-	-	-	-	-	-	-

Marasmius section *Sicci* Singer, subsect. *Siccini* Singer, ser. *Spinulosi* (Cl  men  on) Desjardin in Anton  n & Noordeloos, Lib. Bot. 8: 179. 1993.

Marasmius nummularioides Desjardin & Y.S. Tan, **sp. nov.** (Fig. 5)
MycoBank: 510521.

Pileus 5-16 mm latus, convexus, ad discum rugulosus, leves marginum versus, haud striatus, minute velutinus, rufobrunneus vel brunneus. *Lamellae* adnatae, densae (16-18), angustatae, pallide stramineae, brunneomarginatae. *Stipes* 16-40 × 1 mm, teres, aequalis, pruinosis vel hispidulus, haud insititius, primo luteus vel aurantio-brunneus, dein brunneus, ad basim tomento aurantio-brunneus strigosoque affixus. *Basidiosporae* 16-18 × 4-4.5 μm, clavatae vel fusioideae, leves, hyalinae, inamyloideae. *Basidiola* clavata vel fusioidea. *Cheilocystidia* typi Sicci, cellulae 14-20 (-28) × 6-10 μm, setulosae, cylindricae vel late clavatae, hyalinae, tenui-tunicatae vel crasse-tunicatae, setulae ad apicem 4-8 × 0.5-1 μm, densae, cylindricae vel conicae, subacutae vel obtusae, pallide fulvae, dextrinoideae, crasse-tunicatae. *Pleurocystidia* nulla. *Pileipellis* hymeniformis, cellulae typi Sicci 10-30 × 6-10 (-13) μm, setulosae, clavatae vel irregulares, hyalinae vel pallide fulvae, dextrinoideae, crasse-tunicatae, setulae ad apicem 5-13 (-17) × 1-2 μm, cylindricae vel conicae, pallide fulvae vel brunneae, dextrinoideae, crasse-tunicatae. *Trama pilei* irregulare, trama lamellarum regulare, hyphis dextrinoideis instructum. *Caulocystidia* versiformae: a) cellulae typi Sicci 14-25 × 8-15 μm, cylindricae vel late clavatae, stramineae vel pallide brunneae, crasse-tunicatae, setulae ad apicem 6-60 × 2-4 μm, conicae vel aciculae, stramineae, inamyloideae, crasse-tunicatae; b) cauloetae 50-100 × 3-5 μm, lanceolatae, pallide brunneae, inamyloideae, crasse-tunicatae. *Fibulae* presentes. Solitarius vel gregarius, ad folia putrida plantarum dicotyledonearum. **Holotypus** hic designatus: Malaysia, Johor, Endau Rompin National Park, Peta Village, Temiang trail, 14 July 2005, Y.S. Tan #508 (**holotypus** KLU-M #7; **isotypus** SFSU).

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 × 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) × (3.5-) 4-4.5 μm [\bar{x} = 16.7 ± 1.1 × 4.1 ± 0.3 μm, Q = 3.5-4.8, Q_m = 4.0 ± 0.3, n = 22 spores], elongate-lacrimoid 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* sub-parallel 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 setae; main body of broom cells and setae-like cells 14-25 \times 8-15 μm , cylindrical to broadly clavate, light yellow to light brown, inamyloid, thick-walled; apical setulae 6-60 \times 2-4 μm , conical to acicular, light yellow, inamyloid, thick-walled. *Setae* scattered, 50-100 \times 3-5 μm , lanceolate, light brown, inamyloid, thick-walled. *Clamp connections* present.

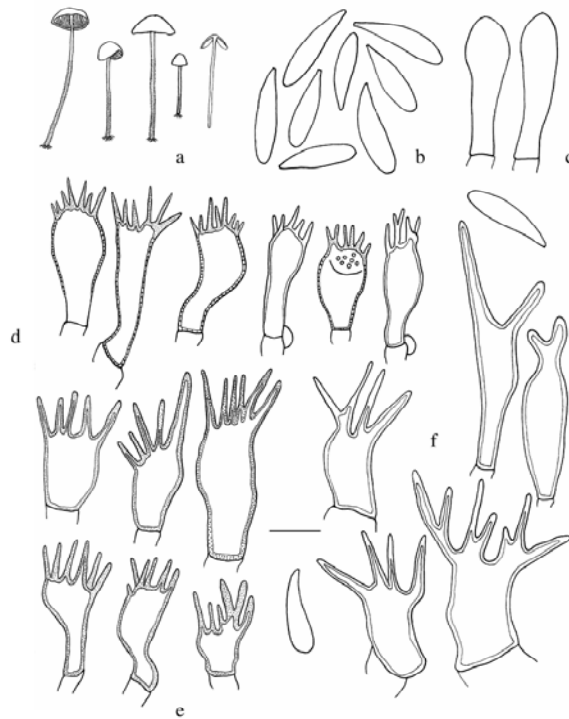


Fig. 5. *Marasmius nummularioides* (TYS 508, holotype). **a.** Basidiomes. **b.** Basidiospores. **c.** Basidioles. **d.** Cheilocystidia. **e.** Pileipellis. **f.** Caulocystidia. Bars: a = 10 mm, b-f = 10 μm .

Habit, habitat and distribution: solitary and gregarious on undetermined dicotyledonous leaves. Johor, Malaysia.

Material examined: MALAYSIA, Johor, 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).

Etymology: nummularioides = like *Marasmius nummularius* Berk. & Broome, a species sharing many features with the new species.

Mating system: TYS 508 = Bipolar (unifactorial). See Table 5.

Isolate mating type assignment: A₁:5*, 12, 17, 19, 22, 26, 30; A₂: 6, 10, 11*, 13, 14, 15, 20, 25, 29.

Notes. *Marasmius nummularioides* is characterized by relatively small, non-striate, rugulose pileus colored 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 $16.7 \times 4.1 \mu\text{m}$, has *Siccus*-type cheilocystidia and pileipellis broom cells, and lacks pleurocystidia, hymenial setae and pileosetae.

Table 5. Self-crosses between 16 single spore isolates of *Marasmius nummularioides* (TYS 508). + = presence of clamp connection; - = absence of clamp connection; NA = not available (contaminated or no growth).

	A ₁								A ₂							
	5*	12	17	19	22	26	30	6	10	11*	13	14	15	20	25	29
5	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+
12	-	-	-	-	-	-	-	+	+	+	+	+	+	NA	+	-
17	-	-	-	-	-	-	-	NA	+	+	+	+	+	+	+	+
19	-	-	-	-	-	-	-	+	+	+	-	+	+	+	+	+
22	-	-	-	-	-	-	-	+	+	+	+	-	+	+	+	+
26	-	-	-	-	-	-	NA	+	+	+	+	+	+	+	+	+
30	-	-	-	-	-	NA	-	+	NA	+	+	NA	+	+	+	+
6	+	+	NA	+	+	+	+	-	-	NA	-	-	-	-	-	NA
10	+	+	+	+	+	+	NA	-	-	-	-	-	-	-	-	-
11	+	+	+	+	+	+	+	NA	-	-	-	-	NA	-	-	-
13	+	+	+	-	+	+	+	-	-	-	-	-	-	-	-	-
14	+	+	+	+	-	+	NA	-	-	-	-	-	NA	-	-	-
15	+	+	+	+	+	+	+	-	-	NA	-	NA	-	-	-	-
20	+	NA	+	+	+	+	+	-	-	-	-	-	-	-	-	-
25	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-
29	+	-	+	+	+	+	+	NA	-	-	-	-	-	-	-	-

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 ($\bar{x} = 13.6 \times 4 \mu\text{m}$) and in having a stipitipellis covered with very long, usually simple caulosetae, 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 caulosetae, lacking *Siccus*-type broom cells (Singer, 1976; Pegler, 1983; K!).

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

Marasmius haematocephalus (Mont.) Fr., Epict. Syst. Mycol.: 382. 1838.

(Fig. 6)

≡ *Agaricus haematocephalus* Mont., Ann. Sci. Nat. Bot., sér. 2, 7: 369. 1837.

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

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

Taxonomic synonyms:

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

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

= *Marasmius semipellucidus* Berk. & Broome, J. Linn. Soc., Bot. 14: 36. 1875.

= *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.

Pileus 2-7 mm in diam; obtusely conical to convex with a small central papilla, 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 × 1 mm, central, cylindrical, twisted-fibrous, dry, dull, glabrous, non-insititious, arising from white basal mycelium, dark brown overall.

Basidiospores (15-) 17-20 (-23) × (3.5-) 4-4.5 μm [\bar{x} = 18.2 ± 1.6 × 3.8 ± 0.5 μm, Q = 4-5.3, Q_m = 4.8 ± 0.6, n = 40 spores], elongate-lacrimoid to fusoid or clavate, smooth, hyaline, inamyloid. *Basidia* not observed. *Basidioles* 17-28 × 8-12.5 μm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body 8-21 × (5-) 7-10 μm, subcylindrical to clavate or broadly clavate, hyaline, inamyloid, thin- to thick-walled; apical setulae 2-6 × 0.5-2 μm, crowded, cylindrical to conical, subacute to obtuse, hyaline to light yellow, thin- to thick-walled. *Pleurocystidia* scattered, 30-42 × 7-10 μm, 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 μm beyond basidioles. *Pileipellis* mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 9-20 × 5-13 μm,

subcylindrical to clavate or broadly clavate, hyaline to yellowish-brown, 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, 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 in lamellar trama.

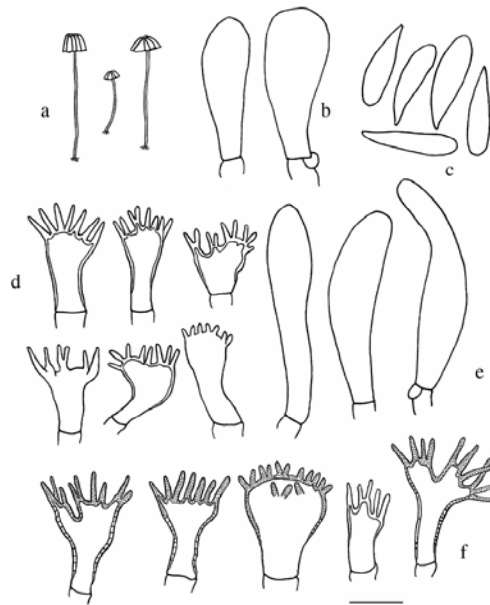


Fig. 6. *Marasmius haematocephalus* Corner (TYS 523). **a.** Basidiomes. **b.** Basidioles. **c.** Basidiospores. **d.** Cheilocystidia. **e.** Pleurocystidia. **f.** Pileipellis. Bars: a = 10 mm, b-f = 10 μm .

Habit, habitat and distribution: gregarious on undetermined dicotyledonous leaves. Selangor, Malaysia.

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).

Mating system: TYS 523 = Bipolar (unifactorial). See Table 6.

Isolate mating type assignment: A₁: 1, 7*, 13, 15; A₂: 4, 8, 10, 11, 12, 14, 19, 22*, 25, 27.

Notes. This is the purple form of *M. haematocephalus* that is widespread in the Old World tropics. Our material from Malaysia matched that described from Sri Lanka (Pegler, 1986), Papua New Guinea (Desjardin and 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 mean spore 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 $20.5 \times 4 \mu\text{m}$.

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), our report of a bipolar mating system for an Old World population of *M. haematocephalus* is consistent with that of New World populations.

Table 6. Self-crosses between 14 single spore isolates of *Marasmius haematocephalus* (TYS 523). + = presence of clamp connection; - = absence of clamp connection; NA = not available (contaminated or no growth).

	A ₁							A ₂						
	1	7*	13	15	4	8	10	11	12	14	19	22*	25	27
1	-	-	-	+	+	+	NA	+	+	+	+	+	+	+
7	-	-	-	+	+	+	+	+	+	+	+	NA	+	+
13	-	-	-	+	+	+	+	+	+	+	+	+	+	+
15	-	-	-	+	+	+	+	+	+	+	NA	+	+	+
4	+	+	+	+	-	-	NA	-	-	-	-	-	-	-
8	+	+	+	+	-	-	-	-	-	-	-	-	-	-
10	+	+	+	+	-	-	-	NA	-	-	-	-	-	-
11	NA	+	+	+	NA	-	-	NA	NA	-	-	-	-	-
12	+	+	+	+	-	-	NA	NA	NA	NA	-	-	-	-
14	+	+	+	+	-	-	NA	NA	NA	-	-	-	-	NA
19	+	+	+	NA	-	-	-	-	-	-	-	-	-	-
22	+	NA	+	+	-	-	-	-	-	-	-	-	-	-
25	+	+	+	+	-	-	-	-	-	-	-	-	-	-
27	+	+	+	+	-	-	-	-	-	NA	-	-	-	-

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

Marasmius berambutanus Desjardin, Retnowati & E. Horak, Sydowia, 52: 116. 2000. (Fig. 7)

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 × 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) × 3-5 (-5.5) μm [$x_{mr} = 8.2-9.5 \times 3.3-4.5$ μm, $x_{mm} = 9.1 \pm 0.8 \times 4.0 \pm 0.5$ μm, $Q = 1.5-3.3$, $Q_{mr} = 2.0-2.5$, $Q_{mm} = 2.3 \pm 0.3$ μm, $n = 30$ spores per 5 collections], ellipsoid, smooth, hyaline, inamyloid. *Basidia* 22-30 × 5-7 μm, clavate, 4-spored. *Basidioles* 18-26 × 5-7 μm, fusoid to clavate. *Cheilocystidia* abundant, composed of *Siccus*-type broom cells; main body 10-20 (-28) × 5-10 (-13) μm, subclavate to broadly clavate or subcylindrical, seldom lobed, hyaline, inamyloid, thin- to thick-walled; apical setulae 4-8 (-12) × 1-2.5 μm, 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 hymenium layer of *Siccus*-type broom cells and pileosetae; 1) *Siccus*-type cells with main body 10-24 × 6-13 μm, subclavate to clavate or irregular in outline, often lobed, hyaline to brownish-yellow, inamyloid, thick-walled; apical setulae 5-16 (-26) × 1-2 μm, cylindrical to conical or irregular, subacute to obtuse, light yellow to yellowish-brown, inamyloid, thick-walled; 2) pileosetae 26-60 × 4-7 μm, filiform to lanceolate or irregular in outline, sometimes branched with apical setulae up to 100 μm long, base often swollen up to 10 μm diam, inamyloid, thick-walled; numerous cells transitional between typical broom cells and setae, with 4-6 simple or forked setulae up to 40 μm long. *Pileus trama* subparallel to interwoven, hyphae 2-6 μm diam, cylindrical, hyaline, inamyloid, thin-walled, non-gelatinous. *Lamellar trama* regular, hyphae 3-7 μm diam, cylindrical, hyaline, inamyloid to weakly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-6 μm diam, parallel, cylindrical, smooth, dark brown, inamyloid, thick-walled (0.5-1 μm); medullary hyphae 2-5 μm diam, parallel, cylindrical, smooth, hyaline, inamyloid, thin- to thick-walled. *Caulocystidia* absent. *Clamp connections* present.

Habit, habitat and distribution: gregarious on leaves of undetermined dicotyledonous plants. Kedah, Johor, Kuala Lumpur, Malaysia.

Material examined: MALAYSIA, Kedah, Langkawi Island, Matchinchang Forest Reserve, 1 Sept. 2004, Yee-Shin Tan, TYS 337 (KLU-M #11, SFSU); Johor, 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); Johor, Endau 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); Kuala Lumpur, MNS heritage trail, 6 May 2004, Yee-Shin Tan, KUM 60168 (KLU-M #14, SFSU).

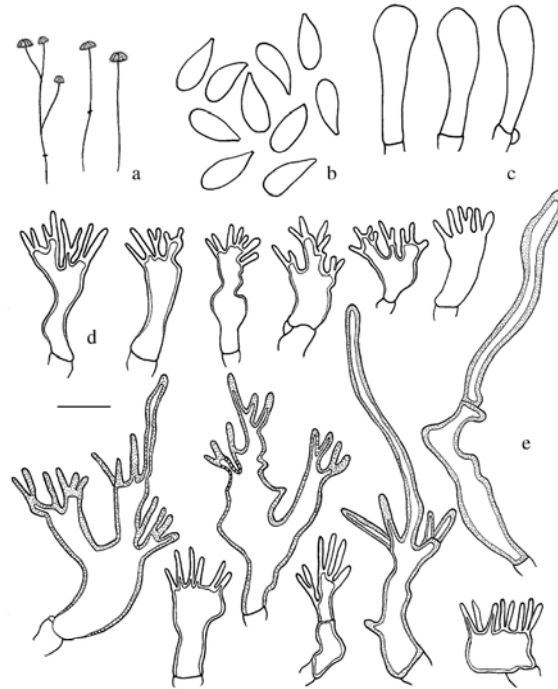


Fig. 7. *Marasmius berambutanus* (TYS 485). **a.** Basidiomes. **b.** Basidiospores. **c.** Basidioles. **d.** Cheilocystidia. **e.** Pileipellis. Bars: a = 10 mm, b-e = 10 μ m.

Mating system: TYS 485 = Tetrapolar (bifactorial). See Table 7.

Isolate mating type assignment: A₁B₁: 1, 7, 28*; A₂B₂: 6, 20*, 21, 29, 32; A₁B₂: 4*, 25; A₂B₁: 11*, 13, 17, 22, 26.

Additional specimen. *Mating system:* TYS 493 = Tetrapolar (bifactorial). Crossing data not shown. *Isolate mating type assignment:* A₁B₁: 2*, 6; A₂B₂: 10, 12, 14, 16, 17, 18, 21, 24, 25*; A₁B₂: 1*, 22, 23; A₂B₁: 3*.

Notes. *Marasmius berambutanus* was described from material collected from a single site on Mt. Halimun, Java. This is the first report of the species from Malaysia. The tiny, collariate basidiomes with pileosetae and *Siccus*-type pileipellis broom cells with elongated setulae are diagnostic for the species.

Table 7. Self-crosses between 15 single spore isolates of *Marasmius berambutanus* (TYS 485). + = presence of clamp connection; - = absence of clamp connection; NA = not available (contaminated or no growth).

	A ₁ B ₁			A ₂ B ₂				A ₁ B ₂			A ₂ B ₁				
	1	7	28*	6	20*	21	29	32	4*	25	11*	13	17	22	26
1	-	-	-	+	NA	+	+	+	-	-	-	-	-	-	-
7	-	-	-	+	+	+	+	NA	-	-	-	-	-	-	-
28	-	-	-	+	+	NA	+	+	-	-	-	-	-	-	-
6	+	+	+	-	-	-	-	NA	-	-	-	-	NA	-	NA
20	NA	+	+	-	-	-	-	-	-	-	-	-	-	-	-
21	+	+	NA	-	-	-	-	-	-	-	-	-	-	-	-
29	+	+	+	-	-	-	-	-	-	-	-	-	NA	-	-
32	+	NA	+	NA	-	-	-	-	-	-	NA	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	+	+	+	+	NA
25	-	-	-	-	-	-	-	-	-	-	NA	+	+	NA	+
11	-	-	-	-	-	-	-	NA	+	NA	-	-	-	-	-
13	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-
17	-	-	-	NA	-	-	NA	-	+	+	-	-	-	-	-
22	-	-	-	-	-	-	-	-	+	NA	-	-	-	-	-
26	-	-	-	NA	-	-	-	-	NA	+	-	-	-	-	-

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

Type: Singapore, Corner s.n., 2 April 1941 (E!).

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 [\bar{x} = 18.8 ± 1.4 × 3.7 ± 0.4 μm, Q = 4-6.6, Q_m = 5.1 ± 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,

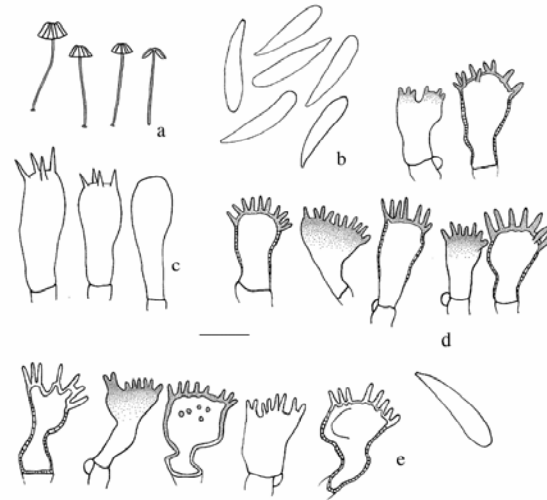


Fig. 8. *Marasmius brevicollis* (TYS 517). **a.** Basidiomes. **b.** Basidiospores. **c.** Basidia and basidioles. **d.** Cheilocystidia. **e.** Pileipellis. Bars: a = 10 mm, b-e = 10 μm .

smooth, hyaline, weakly dextrinoid, thin-walled. *Caulocystidia* absent. *Clamp connections* present.

Habit, habitat and distribution: gregarious on undetermined dicotyledonous leaves. Johor, Malaysia.

Material examined: MALAYSIA, Johor, Endau Rompin National Park, NERC, Peta Village, on the way to jetty, 14 Jul. 2005, Yee-Shin Tan, TYS 517 (KLU-M #15, SFSU).

Mating system: TYS 517 = Tetrapolar (bifactorial). See Table 8.

Isolate mating type assignment: A₁B₁: 1, 4, 15*, 16, 17, 20; A₂B₂: 5*, 11; A₁B₂: 8, 27*, 29; A₂B₁: 6, 9*, 21, 23.

Notes. Diagnostic features of this species include: a small sulcate-umbilicate pileus colored 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 \times 3-4 μm (\bar{x} = 18.8 \times 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).

Table 8. Self-crosses between 15 single spore isolates of *Marasmius brevicollis* (TYS 517). + = presence of clamp connection; - = absence of clamp connection; NA = not available (contaminated or no growth).

	A ₁ B ₁		A ₂ B ₂		A ₁ B ₂		A ₂ B ₁								
	1	4	15*	16	17	20	5*	11	8	27*	29	6	9*	21	23
1	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-
4	-	-	-	-	-	-	+	+	-	NA	-	-	-	-	-
15	-	-	-	-	-	-	+	+	-	-	-	-	-	NA	-
16	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-
17	-	-	-	-	-	-	+	+	-	-	-	-	-	NA	-
20	-	-	-	-	-	-	+	+	-	NA	-	-	-	-	-
5	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-
11	+	+	+	+	+	+	-	-	-	-	NA	-	NA	NA	NA
8	-	-	-	-	-	-	-	-	-	-	-	+	+	+	NA
27	-	NA	-	-	-	NA	-	-	-	-	-	+	+	+	+
29	-	-	-	-	-	-	-	NA	-	-	-	+	+	+	+
6	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
9	-	-	-	-	-	-	-	NA	+	+	+	-	-	-	-
21	-	-	NA	-	NA	-	-	NA	+	+	+	-	-	-	-
23	-	-	-	-	-	-	-	NA	NA	+	+	-	-	-	-

Marasmius gracilichorda Corner, Beih. Nova Hedwigia 111:57. 1996. (Fig. 9)

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

Pileus 1-3 mm diam, convex, umbilicate, sulcate; surface dry, dull, minutely velutinous; reddish-brown (8E7) to dark brown (6E8, 8F7-8) overall with a tiny black dot in the umbilicus. *Lamellae* adnate to a collarium, distant (6-9), yellowish-white (2A2) with brown marginate edges. *Stipe* 8-12 × 0.2 mm, central, cylindrical, filiform, dry, dull, glabrous, insititious, yellowish-white at apex, black at base.

Basidiospores 8-11 × (3-) 3.5-4.5 μm [\bar{x} = 9.5 ± 1.1 × 3.9 ± 0.4 μm, Q = 1.8-3.3, Q_m = 2.4 ± 0.4, n = 30 spores], ellipsoid, smooth, hyaline, inamyloid. *Basidia* 23-27 × 6-7 μm, clavate, 4-spored. *Basidioles* 23-26 × 6-7 μm, fusoid to clavate. *Cheilocystidia* numerous, composed of *Siccus*-type broom cells; main body 10-20 × 5-10 μm, subcylindrical to clavate or broadly clavate, rarely lobed, light yellow to light brown, inamyloid, thin-walled; apical setulae 5-8 × 0.5-1.5 μm, crowded, rarely forked, cylindrical to conical, subacute to obtuse, brownish-yellow to light brown, inamyloid, thick-walled.

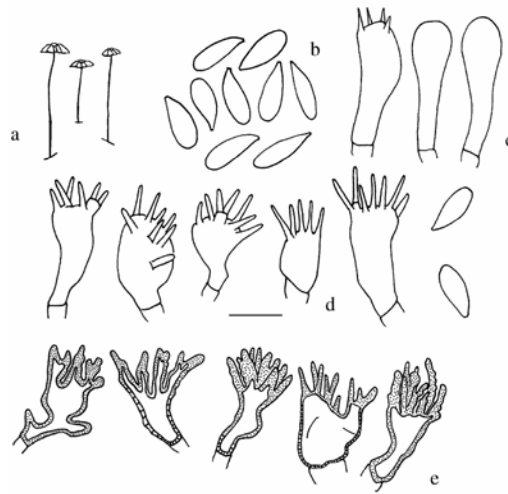


Fig. 9. *Marasmius gracilichorda* (TYS 442). **a.** Basidiomes. **b.** Basidiospores. **c.** Basidia and basidioles. **d.** Cheilocystidia. **e.** Pileipellis. Bars: a = 10 mm, b-e = 10 μ m.

Pleurocystidia absent. *Pileipellis* strongly mottled, composed of a hymeniform layer of *Siccus*-type broom cells; main body 10-17 \times 6-12 μ m, turbinate to clavate, broadly clavate or irregular in outline, often lobed, light brown to reddish-brown, inamyloid, some thin-walled and with shorter setulae and others thick-walled with longer and more coarsely warted setulae; apical setulae 5-12 \times 0.5-1.5 μ 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 3-4 μ m diam, cylindrical, hyaline to light yellow, inamyloid, thin-walled, non-gelatinous. *Lamellar trama* regular, hyphae 3-5 μ m diam, cylindrical, hyaline, inamyloid to weakly dextrinoid, thin-walled, non-gelatinous. *Stipe tissue* monomitic; cortical hyphae 4-5 μ m diam, parallel, cylindrical, smooth, brown, inamyloid, thick-walled (-0.5 μ m); medullary hyphae 2-4 μ m diam, parallel, cylindrical, smooth, hyaline, inamyloid, thin-walled. *Caulocystidia* absent. *Clamp connections* present.

Habit, habitat and distribution: gregarious on undetermined dicotyledonous leaves. Selangor, Malaysia.

Material examined: MALAYSIA, Selangor, Hulu Langat, Sungai Chongkak Forest Reserve, 6 March 2005, Yee-Shin Tan, TYS 442 (KLU-M #16, SFSU).

Mating system: TYS 442 = Tetrapolar (bifactorial). See Table 9.

Isolate mating type assignment: A₁B₁: 2*, 10; A₂B₂: 4, 7, 11, 14, 16*; A₁B₂: 3, 6, 8*, 9; A₂B₁: unrepresented in sample.

Notes. The most distinctive feature of *M. gracilichorda* Corner 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 μm long, and many thicker-walled and more deeply pigmented broom cells with setulae 5-12 μm 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.

Table 9. Self-crosses between 11 single spore isolates *Marasmius gracilichorda* (TYS 442). + = presence of clamp connection; - = absence of clamp connection; NA = not available (contaminated or no growth).

	A ₁ B ₁		A ₂ B ₂				A ₁ B ₂				
	2*	10	4	7	11	14	16*	3	6	8*	9
2		-	NA	+	+	+	+	-	-	-	-
10	-		+	NA	NA	NA	+	-	-	-	-
4	NA	+		-	-	-	-	-	-	-	-
7	+	NA	-		-	-	-	-	-	-	-
11	+	NA	-	-		-	-	-	-	-	NA
14	+	NA	-	-	-		-	-	-	-	-
16	+	+	-	-	-	-		-	-	-	-
3	-	-	-	-	-	-	-		-	-	-
6	-	-	-	-	-	-	-	-		NA	-
8	-	-	-	-	-	-	-	-	NA		-
9	-	-	-	-	NA	-	-	-	-	-	

Marasmius sect. *Marasmius* subsect. *Marasmius*

Marasmius tubulatus Petch, Trans. Brit. Mycol. Soc. 31:42. 1948. (Fig. 10)

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

Pileus 3-12 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 \times 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 (-10.5) \times 3-4.5 (-5) μm , [$x_{\text{mr}} = 8.7-10.3 \times 3.9-4.1 \mu\text{m}$, $x_{\text{mm}} = 9.3 \pm 0.6 \times 4 \pm 0.2 \mu\text{m}$, $Q = 1.7-3.3$, $Q_{\text{mr}} = 2.2-2.7$, $Q_{\text{mm}} = 2.4 \pm 0.1$, $n = 23$ spores per 6 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

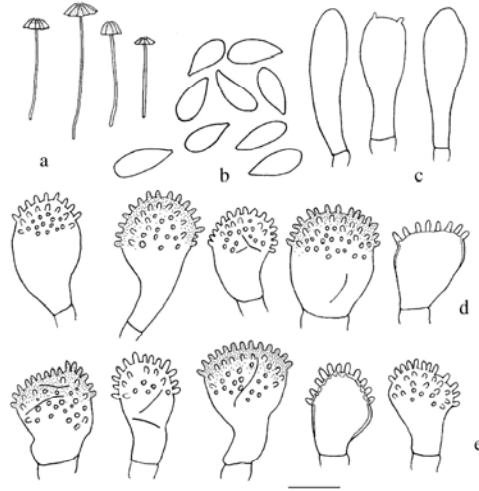


Fig. 10. *Marasmius tubulatus* (TYS 502). **a.** Basidiomes. **b.** Basidiospores. **c.** Basidia and basidioles. **d.** Cheilocystidia. **e.** Pileipellis. Bars: a = 10 mm, b-e = 10 μm.

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 hymenium 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 distribution: gregarious on leaves of undetermined dicotyledonous trees. Johor, Malaysia.

Material examined: MALAYSIA, Johor, Endau Rompin National Park, along the way to NERC, Peta Village and Temiang Trail, 14 July 2005, Yee-Shin Tan, TYS 502 (KLU-M #17, SFSU); same location, 14 July 2005, Yee-Shin Tan, TYS 504 (KLU-M #18, SFSU); same location, 14 July 2005, Yee-Shin Tan, TYS 505 (KLU-M #21, SFSU); same location, 14 July 2005, Yee-Shin Tan, TYS 510 (KLU-M #19, SFSU); same location, 14 July 2005, Yee-Shin Tan, TYS 512 (KLU-M #20, SFSU); same location, 14 July 2005, Yee-Shin Tan, TYS 518 (KLU-M #22, SFSU).

Mating system: TYS 518 = Tetrapolar (bifactorial). See Table 10. Two additional specimens of *M. tubulatus* (TYS 502 and TYS 504) were also tetrapolar and tester strains from the latter two specimens were partially interfertile with TYS 518 indicating a multiallelic system (data not shown).

Isolate mating type assignment: A₁B₁: 3, 7*, 15; A₂B₂: 2, 5, 12, 21*; A₁B₂: 9, 16, 18, 26*; A₂B₁: 4, 11*, 13, 14, 25, 27, 28.

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, by relatively small basidiospores in the range 8-10 × 3-4.5 μm (\bar{x} = 9.3 × 4 μm), by 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, 1948) 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.

Table 10. Self-crosses between 18 single spore isolates of *Marasmius tubulatus* (TYS 518). + = presence of clamp connection; - = absence of clamp connection; NA = not available (contaminated or no growth)

	A ₁ B ₁			A ₂ B ₂			A ₁ B ₂			A ₂ B ₁								
	3	7*	15	2	5	12	21*	9	16	18	26*	4	11*	13	14	25	27	28
3	-	-	-	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	+	+	+	NA	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	+	+	+	NA	-	-	-	NA	-	-	-	-	-	-	NA
2	+	+	+	-	-	NA	-	-	-	-	-	-	-	-	-	-	-	-
5	+	+	+	-	-	-	-	-	-	-	-	NA	-	-	-	-	-	-
12	+	+	+	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	+	NA	NA	-	-	-	-	-	-	-	-	NA	-	-	-	NA	-	-
9	-	-	-	-	-	-	-	-	-	-	-	NA	+	+	+	+	+	+
16	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	NA
18	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+
26	-	-	NA	-	-	-	-	-	-	-	-	+	+	+	+	NA	+	+
4	-	-	-	-	NA	-	NA	NA	+	+	+	-	-	-	NA	-	-	-
11	-	-	-	-	-	-	-	+	+	+	+	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	+	+	+	+	-	-	-	NA	-	-	-
14	-	-	-	-	-	-	-	+	+	+	+	NA	-	NA	-	-	-	-
25	-	-	-	-	-	-	NA	+	+	+	NA	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	+	+	+	+	-	-	-	-	-	-	-
28	-	-	NA	-	-	-	-	+	NA	+	+	-	-	-	-	-	-	-

Discussion

We restrict the genus *Marasmius* to include only members of sections *Marasmius*, *Sicci*, *Globulares*, *Hygrometrici*, *Neosessiles* and *Leveilleani* as promoted by Wilson and Desjardin (2005). The remaining traditional sections of *Marasmius* accepted by Singer (1976, 1986) are distantly related and either represents distinct genera or are considered synonyms of other genera (cf. Wilson and Desjardin 2005). This is the first report of mating systems operating in *Marasmius s.s.* species from southeast Asia. We report that six species from sect. *Sicci* are bipolar and four species from sect. *Marasmius* are tetrapolar. This pattern is consistent with the data reported on *Marasmius* species from temperate habitats of North America and Europe by Vandendries (1936), Burnett and Evans (1966), Lamoure (1989), Gordon and Petersen (1991), Desjardin *et al.* (1992), and Gordon *et al.* (1994). Petersen (1995) provided a summary of known data on the mating systems in *Marasmius s.l.*, indicating that all tested members of sect. *Sicci* are bipolar while those of sect. *Marasmius* are tetrapolar. Our data on tropical Old World species concur with these findings.

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