forests

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*Article*

# *Crinipellis deutziae*, *Marasmius pinicola* spp. nov., and *C. rhizomaticola* (Agaricales, Basidiomycota) New to China from Beijing

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**Abstract:** Specimens of *Crinipellis* and *Marasmius* (Marasmiaceae) collected from Beijing, North China, were studied by morphological and molecular methods. Phylogenetic analyses were performed separately for the two genera based on ITS sequence data. Two new species, *C. deutziae* and *M. pinicola*, were found, and *C. rhizomaticola* was reported from China for the first time. *Crinipellis deutziae* is characterized by small basidiocarps, large and variably shaped basidiospores measuring 8.8–11 × 7.5–9.5 µm, the presence of both cheilocystidia and pleurocystidia, and growing on *Deutzia parviflora*. *Marasmius pinicola* is characterized by small basidiocarps, cylindrical, reniform to phaseoliform basidiospores measuring 6–8 × 3.5–4.2 µm, often capitate cheilocystidia, and pleurocystidia, and growing on fallen leaves of *Pinus tabuliformis*. Descriptions and illustrations are provided for the three species. The results of this study contribute to the knowledge of the species diversity of macro-fungi in Beijing.

**Keywords:** mushroom; new species; saprotrophic; species diversity; taxonomy



**Citation:** Li, Y.; He, S.-H.; Zhang, Y.-Z.; Liang, J.-Q.; Sheng, W.-Y.; Si, J.; Li, H.-J. *Crinipellis deutziae*, *Marasmius pinicola* spp. nov., and *C. rhizomaticola* (Agaricales, Basidiomycota) New to China from Beijing. *Forests* **2023**, *14*, 1480. https://doi.org/10.3390/f14071480

Academic Editors: Nian-Kai Zeng, Li-Ping Tang and Dong-Qin Dai

Received: 8 June 2023
Revised: 2 July 2023
Accepted: 16 July 2023
Published: 19 July 2023



## 1. Introduction

*Crinipellis* Pat., typified by *Agaricus stipitarius* Fr. (=*C. scabella* (Alb. & Schwein.) Murrill), has a worldwide distribution, and now 193 names are included under the genus (http://www.indexfungorum.org, accessed on 1 May 2023). Most species are saprotrophic, but there are a few parasitic species, such as *C. siparunae* Singer, *C. pseudostipitaria* Singer, and *C. scabella* [1]. Morphologically, species of *Crinipellis* are characterized by the pileus and usually also stipe covered with thick-walled, dextrinoid, hair-like terminal cells [2]. Previous phylogenetic studies showed that *Crinipellis* is sister to *Chaetocalathus* Singer, *Moniliophthora* H.C. Evans, Stalpers, Samson & Benny, and *Marasmius* Fr. sensu stricto [1]. Although the genus in Asia has been intensively studied and many new species have been described, only two species, *C. bidens* T. Bau and *C. floccosa* T.H. Li, Y.W. Xia & W.Q. Deng, were described in China recently [1,3–9].

*Marasmius*, typified by *M. rotula* (Scop.) Fr., is characterized by the thin and small to large and robust basidiocarps, generally with membranous, dull, dry, white to strongly pigmented pilei, lamellate hymenophore, mostly tough and strongly pigmented stipe, hyaline, smooth and inamyloid spores, and a hymeniform pileipellis of smooth or diverticulate cells [2,10–14]. There are 2054 records of *Marasmius* in Index Fungorum (http://www.indexfungorum.org, accessed on 1 May 2023), but about 600 species are accepted [15–18]. Singer [2] divided this genus into twelve sections: *Androsacei*, *Alliacei*, *Epiphylli*, *Fusicystides*, *Globulares*, *Hygrometrici*, *Inaequales*, *Leveilleani*, *Marasmius*, *Neosessiles*, *Scotophysini*, and *Sicci*, but Wilson and Desjardin [12] restricted it to six sections, viz. *Sicci*, *Glob-*

*ulares*, *Marasmius*, *Neosessiles*, *Leveilleani*, and *Hygrometrici*. Jenkinson et al. [19] established the genus *Cryptomarasmius* T.S. Jenkinson & Desjardin based on the section *Hygrometrici*.

The species diversity of macro-fungi in Beijing, China, is relatively rich because of the special topography with many kinds of plants. Intensive investigations in Beijing were carried out by some mycologists in recent years, and several new species were described [20–26]. Recently, careful morphological and molecular studies on the specimens of Marasmiaceae revealed two additional new species of *Crinipellis* and *Marasmius* and a new Chinese record *C. rhizomaticola*, which are described and illustrated as follows. The results of this study contribute to the knowledge of the species diversity of macro-fungi in Beijing.

## 2. Materials and Methods

### 2.1. Morphological Studies

All the studied specimens were processed and deposited in the fungoria of Beijing Forestry University, Beijing, China (BJFC) and the National Institute of Occupational Health and Poison Control, Chinese Center for Disease Control (NIOHP, China CDC). Macro-morphological descriptions were based on field notes and color photos of basidiocarps. Color codes followed Petersen [27]. In the description of basidiospores, the abbreviation [n/m/p] means 'n' basidiospores measured from 'm' basidiocarps of 'p' collections; dimensions for basidiospores are given using the following notation form (a−) b–c (−d). The range 'b–c' contains a minimum of 90% of the measured values, extreme values (a, d) are given in parentheses. L means spore length (arithmetic average of all spores). W means spore width (arithmetic average of all spores). Q means the "length/width ratio" of a spore in side-view; Qm means the average Q of all basidiospores measured ± sample standard deviation. The following abbreviations were used: IKI = Melzer's reagent, IKI− = neither amyloid nor dextrinoid, KOH = 5% potassium hydroxide, CB = cotton blue, CB− = acyanophilous.

### 2.2. DNA Extraction and Sequencing

The Phire® Plant Direct PCR Kit (Finnzymes Oy, Espoo, Finland) was used to obtain PCR products from dried specimens, according to the manufacturer's instructions, with some modifications [28]. ITS5/ITS4 were used to amplify the internal transcribed spacer (ITS) regions [29]. Tang et al. PCR procedures were followed [28]. All newly generated sequences in this study were deposited in GenBank (OQ538294–OQ538297, OQ941785, OQ941786).

### 2.3. Phylogenetic Analyses

Phylogenetic analyses of *Crinipellis* and *Marasmius* were performed separately based on the ITS sequences. *Marasmius rotula* and *C. zonata* (Peck) Pat. were selected as the outgroups for the two datasets, respectively. The ITS sequences were aligned using MAFFT v.74 [30] with the G-INS-I iterative refinement algorithm and optimized manually in BioEdit v.7.0.5.3. Maximum parsimony (MP), maximum likelihood (ML) analyses, and Bayesian inference (BI) were carried out by using PAUP* v.4.0b10, RAxML v.8.2.10, and MrBayes 3.2.6, respectively. The best-fit substitution model was estimated with jModeltest v.2.17. Detailed methods of the analyses referred to Li et al. [25]. MP, ML, and BI were carried out for the *Crinipellis* dataset, while only ML was applied to the *Marasmius* dataset. Four Markov chains were run for 2,000,000 for the *Crinipellis* dataset until the split deviation frequency value was lower than 0.01.

## 3. Results

### 3.1. Phylogenetic Analyses

The *Crinipellis* dataset contained 69 ITS sequences representing 42 ingroup taxa of *Crinipellis* and related genera as well as the outgroup (Table 1). The aligned length was 903 characters, of which 373 were parsimony informative. MP analysis yielded 38 equally

parsimonious trees (TL = 1649, CI = 0.481, RI = 0.800, RC = 0.385, HI = 0.519). The *Marasmius* dataset included 303 ITS sequences representing 197 ingroup taxa and the outgroup (Table 1). The aligned length was 1490 characters. jModelTest suggested GTR + I + G as the best-fit model of nucleotide evolution for the two datasets.

**Table 1.** Species and sequences used in the phylogenetic analyses. New species and the new Chinese record are set in bold; type specimens indicated with an asterisk (*).

| Taxa | Voucher | Locality | ITS |
|---|---|---|---|
| *Crinipellis actinophora* | JFK78 (KLU-M) | Malaysia | FJ167617 |
| *C. actinophora* | JFK80 (KLU-M) | Malaysia | FJ167618 |
| *C. bidens* | S14 | China | MH143792 |
| *C. bidens* | S142 | China | MH143793 |
| *C. birhizomorpha* | VA 12.95 (BRNM751593) | Korea | KF380831 |
| *C. brasiliensis* | CMR UB 2053 | Brazil | AY317137 |
| *C. brunneipurpurea* | JFK107 (KLU-M) | Indonesia | FJ167645 |
| *C. brunneipurpurea* | JFK84 (KLU-M) | Indonesia | FJ167646 |
| *C. brunnescens* | DED6791 (BO) | Indonesia | FJ167627 |
| *C. cupreostipes* | JFK55 (CMU) | Thailand | FJ167640 |
| *C. cupreostipes* | JFK31 (CMU) | Thailand | FJ167641 |
| ***C. deutziae*** | **Li20220703-12 *** | **China** | **OQ538295** |
| ***C. deutziae*** | **Li20220703-21** | **China** | **OQ538296** |
| *C. dipterocarpi* | DED7602 (BO) | Thailand | FJ167651 |
| *C. dipterocarpi* | ZT12031(BO) | Indonesia | FJ167654 |
| *C. dipterocarpi* f. *cinnamomea* | JFK17 (KLU-M) | Malaysia | FJ167648 |
| *C. dipterocarpi* f. *cinnamomea* | JFK32 (KLU-M) | Thailand | FJ167649 |
| *C. floccosa* | GDGM 50000 | China | KJ698641 |
| *C. floccosa* | GDGM 43024 | China | KJ698642 |
| *C. furcata* | JFK103 (BO) | Indonesia | FJ167657 |
| *C. furcata* | DED6951 (BO) | Indonesia | FJ167658 |
| *C.* aff. *iopus* | RW774 (GENT) | Papua New Guinea | FJ167636 |
| *C.* aff. *iopus* | RW829 (GENT) | Papua New Guinea | FJ167638 |
| *C. malesiana* | KUM084a (KLU-M) | Malaysia | FJ167629 |
| *C. malesiana* | AR513 (BO) | Indonesia | FJ167630 |
| *C. mezzanensis* | BRNM 766629 | Italy | KP347691 |
| *C. nigicaulis* | CBM-FB-24125 | Japan | FJ766094 |
| *C. nigicaulis* | RA7210-6 | USA | MN148653 |
| *C. nigicaulis* var. *macrospora* | VA07.96 (BRNM712569) | Korea | FJ573196 |
| *C. nigicaulis* var. *macrospora* | KG231 (BRNM712580) | Korea | FJ573197 |
| *C. nigrolamellata* | LIP 0201684 | France | MT946363 |
| *C. nigrolamellata* | LIP 0201685 | France | MT946364 |
| *C. odorata* | CAL:1240 | India | KT952521 |
| *C. pallidipilus* | VA 12.88 (BRNM751595) | Korea | KF380833 |
| *C. piceae* | DED7622 (SFSU) | USA | FJ167632 |
| *C. piceae* | DED7758 (SFSU) | USA | FJ167633 |
| *C. podocarpi* | Bandala 4333 | Mexico | JF930647 |
| *C. procera* | ZT8490 (ZT) | New Zealand | FJ167660 |
| *C. rhizomaticola* | VA 08.55 (BRNM712570) | Korea | FJ573198 |
| ***C. rhizomaticola*** | **He 7791** | **China** | **OQ538297** |
| *C. scabella* | PB302 | Germany | AY571033 |
| *C. scabella* | ZTBAM98 (ZT) | France | FJ167635 |
| *C. setipes* | JFK34 (CMU) | Thailand | FJ167634 |
| *C. setipes* | Bandala 4031 | Mexico | JF930641 |
| *C. tabtim* | JFK129 (CMU) | Thailand | FJ167643 |
| *C. tabtim* | JFK141 (CMU) | Thailand | FJ167644 |
| *C. tabtim* | Li160629-31 | China | OQ538294 |

**Table 1.** *Cont.*

| Taxa | Voucher | Locality | ITS |
|---|---|---|---|
| *C. trichialis* | ZT6456 (ZT) | Indonesia | FJ167615 |
| *C. trichialis* | JFK97 (SFSU) | Malaysia | FJ167616 |
| *C. wandoensis* | VA 12.90 (BRNM751594) | Korea | KF380832 |
| *C. zonata* | VPI3355 | USA | AY916692 |
| *C. zonata* | DAOM176761 (SFSU) | Canada | FJ167659 |
| *Chaetocalathus columellifer* | JFK72 (SFSU) | Malaysia | FJ167665 |
| *Ch. craterellus* | SN223 (ZT) | Italy | FJ167664 |
| *Ch. fragilis* | DED6359 (SFSU) | Hawaii | FJ167661 |
| *Ch. fragilis* | JFK122 (SFSU) | Thailand | FJ167662 |
| *Ch. galeatus* | JFK67 (SFSU) | Thailand | FJ167663 |
| *Ch. liliputianus* | MCA485 (BPI) | Puerto Rico | AY916682 |
| *Ch. magnus* | DED4763(SFSU) | Colombia | FJ167666 |
| *Moniliophthora aurantiaca* | UTC 253824 | Samoa | JN692482 |
| *Mo. canescens* | DED7518 (SFSU) | Malaysia | FJ167668 |
| *Mo. conchata* var. *brevispora* | VA 12.91 (BRNM751596) | Korea | KF380834 |
| *Mo. perniciosa* | CM49 | Brazil | AY753996 |
| *Mo. perniciosa* | MCA2520 (BPI) | Ecuador | AY916743 |
| *Mo. roreri* | MCA2521 (BPI) | Ecuador | AY194150 |
| *Mo. roreri* | C21 (CATIE) | Costa Rica | AY916746 |
| *Mo. roreri* var. *gileri* | DIS331 | Ecuador | AY230255 |
| *Marasmius acerosus* | TYS458 | Malaysia | FJ431213 |
| *M. acerosus* | TYS427 | Malaysia | FJ431214 |
| *M. adhaesus* | TYS467 | Malaysia | FJ431216 |
| *M. adhaesus* | TYS464 | Malaysia | FJ431217 |
| *M. albimyceliosus* | KP-13 | Pakistan | HF546218 |
| *M. albisubiculosus* | DED 8277 | Principe | KX953752 |
| *M. albopurpureus* | GDGM 57201 | China | KP127674 |
| *M. albopurpureus* | GDGM 57089 | China | KP127675 |
| *M. albulus* | NW627 | Thailand | MZ145122 |
| *M. alienigenus* | JO221 | Brazil | MN714030 |
| *M. alienigenus* | JO147 | Brazil | MN714029 |
| *M. altoribeirensis* | JO532 | Brazil | KP635204 |
| *M. ambicellularis* | JO144 | Brazil | KP635181 |
| *M. andasibensis* var. *obscurostipitatus* | Buyck 00.1699b | Madagascar | KX149005 |
| *M. apatelius* | NW427 | Thailand | EU935561 |
| *M. apatelius* | JES 203 | Madagascar | KX148998 |
| *M. araneocephalus* | NW358 | Thailand | EU935540 |
| *M. araucariae* var. *siccipes* | NW364 | Thailand | EU935511 |
| *M. atrorubens* | JO489 | Brazil | KP635206 |
| *M. atrorubens* | JO528 | Brazil | KP635207 |
| *M. auranticapitatus* | MC4554 | Brazil | ON502670 |
| *M. auranticapitatus* | JO300 | Brazil | ON502677 |
| *M. aurantioferrugineus* | KG 254 | Korea | FJ904962 |
| *M. aurantioferrugineus* | HCCN 3571 | Korea | FJ904964 |
| *M. auratus* | NW076 | Thailand | EU935501 |
| *M. auratus* | NW175 | Thailand | EU935502 |
| *M. avellaneus* | JO244 | Brazil | MN714032 |
| *M. avellaneus* | JO229 | Brazil | MN714033 |
| *M. bambusiniformis* | NW329 | Thailand | EU935521 |
| *M. bambusiniformis* | NW368 | Thailand | EU935522 |
| *M. bekolacongoli* | Lockwood 2131638 | Madagascar | KX148982 |
| *M. bellus* | JO299 | Brazil | KP635208 |
| *M. benghalensis* | SOUMITRA 240 | India | MF189044 |
| *M. benghalensis* | SOUMITRA 205 | India | MF189043 |
| *M. bondoi* | NW320 | Thailand | EU935474 |

**Table 1.** *Cont.*

| Taxa | Voucher | Locality | ITS |
|---|---|---|---|
| *M. bondoi* | NW386 | Thailand | EU935476 |
| *M. brevicollus* | NW128 | Thailand | EU935558 |
| *M. brunneoaurantiacus* | JES 115 | Madagascar | KX149011 |
| *M. brunneoaurantiacus* | JES 113 | Madagascar | KX149009 |
| *M. brunneolorobustus* | BRI:AQ1018016 | Australia | OK044757 |
| *M. brunneolorobustus* | BRI:AQ1017490 | Australia | OK044752 |
| *M. brunneolivascens* | NW112 | Thailand | EU935516 |
| *M. brunneolivascens* | NW373 | Thailand | EU935517 |
| *M. brunneospermus* | BRNM 714569 | Korea | FJ904967 |
| *M. brunneospermus* | KG 237 | Korea | FJ904968 |
| *M. bulliardii* | NN048356 | Denmark | JN943600 |
| *M. bulliardii* | BRNM 705006 | Hungary | JN540056 |
| *M. cafeyen* | NW130 US 34 | Thailand | EU935547 |
| *M. calvocystidiatus* | INPA259374 | Brazil | KU170116 |
| *M. calvocystidiatus* | INPA259372 | Brazil | KU170115 |
| *M. calvus* | NW331 | Thailand | EU935481 |
| *M. campestris* | HKAS 80857 | China | KJ126766 |
| *M. campestris* | HKAS 80858 | China | KJ126767 |
| *M. capillaris* | TENN61532 | USA | FJ596826 |
| *M. castanocephalus* | JO523 | Brazil | ON502679 |
| *M. chrysoblepharioides* | SI-15-24 | Argentina | MF683956 |
| *M. chrysoblepharioides* | SI-5-12 | Argentina | MF683957 |
| *M. cladophyllus* var. *glaberripes* | JO87 | Brazil | KP635163 |
| *M. cladophyllus* var. *glaberripes* | JO518 | Brazil | KP635164 |
| *M. coarctatus* | NW315 | Thailand | EU935541 |
| *M. coarctatus* | NW385 | Thailand | EU935542 |
| *M. coasiaticus* | JO323 | Brazil | ON502680 |
| *M. coasiaticus* | JO339 | Brazil | ON502681 |
| *M. cohaerens* | BRNM 695761 | Korea | GU266260 |
| *M. cohaerens* | BRNM 652833 | Korea | GU266261 |
| *M. cohaerens* var. *lachnophyllus* | DED 4071 | USA | FJ431230 |
| *M. cohaerens* var. *mandshuricus* | LE295987 | Russia | KF774170 |
| *M. cohaerens* var. *mandshuricus* | LE295986 | Russia | KF774171 |
| *M. coklatus* | TYS301 | Thailand | EU935543 |
| *M. colorimarginatus* | DED 8309 | Madagascar | KX953745 |
| *M. conchiformis* | JO117 | Brazil | JX424038 |
| *M. conchiformis* | JO45 | Brazil | KF741996 |
| *M. congregatus* | JO122 | Brazil | KP635165 |
| *M. congregatus* | JO468 | Brazil | KP635168 |
| *M. corneri* | NW269 | Thailand | EU935482 |
| *M. corrugatiformis* | DED 8233 | Sao Tome | KX953757 |
| *M. corrugatiformis* | DED 8326 | Sao Tome | KX953756 |
| *M. corrugatus* | JO336 | Brazil | KP635170 |
| *M. corrugatus* | JO456 | Brazil | KP635171 |
| *M. cremeus* | NW366 | Thailand | EU935494 |
| *M. crinipes* | BRNM 714682 | Korea | FJ917627 |
| *M. crinipes* | BRNM 714694 | Korea | FJ917629 |
| *M. crinisequi* | NW348 | Thailand | EU935555 |
| *M.* aff. *crinisequi* | NW205 | Thailand | EU935565 |
| *M.* aff. *crinisequi* | NW182 | Thailand | EU935564 |
| *M. cupreostipes* | NW150 | Thailand | EU935485 |
| *M. curreyi* | DED 5142 | USA | FJ431237 |
| *M.* aff. *curreyi* | JES 135 | Madagascar | KX149008 |

**Table 1.** *Cont.*

| Taxa | Voucher | Locality | ITS |
|---|---|---|---|
| *M.* aff. *curreyi* | Buyck 97.374 | Madagascar | KX148980 |
| *M. cystidiatus* | 1672 | India | MH216042 |
| *M. cystidiatus* | CAL 1669 | India | MH216191 |
| *M. delectans* | S.D. Russell MycoMap 7736 | USA | MK532846 |
| *M. dendrosetosus* | JES 205 | Madagascar | KX148995 |
| *M. dendrosetosus* | JES 211 | Madagascar | KX148996 |
| *M. dimorphus* | JO298 | Brazil | KP635174 |
| *M. dimorphus* | JO334 | Brazil | KP635175 |
| *M. distantifolius* | TYS478 | Malaysia | FJ431239 |
| *M. diversus* | DED 8263 | Principe | KX953751 |
| *M. edwallianus* | JO15 | Brazil | MN714022 |
| *M. elaeocephaliformis* | DED 8213 | Sao Tome | KX953758 |
| *M. elaeocephalus* | DED 8254 | Sao Tome | KX953754 |
| *M. ferruginoides* | JES 209 | Madagascar | KX148983 |
| *M. fusicystidiosus* | BRNM 714567 | Korea | FJ917624 |
| *M. galbinus* | GDGM 27251 | China | HQ709445 |
| *M. ganyao* | NW005 | Thailand | EU935499 |
| *M. gardneri* | JO491 | Brazil | ON502683 |
| *M. gardneri* | JO454 | Brazil | ON502684 |
| *M. gracilis* | JO90 | Brazil | MN714038 |
| *M. graminicola* | BRNM 714701 | Korea | FJ917621 |
| *M. graminicola* | BRNM 714685 | Korea | FJ917617 |
| *M. graminipes* | NW078 | Thailand | EU935479 |
| *M. graminum* | NN005953 | Denmark | JN943595 |
| *M. grandisetulosus* | DED 8225 | Sao Tome | KX953743 |
| *M. grandisetulosus* | DED 8257 | Sao Tome | KX953744 |
| *M. grandiviridis* | NW152 | Thailand | EU643514 |
| *M. grandiviridis* | NW349 | Thailand | EU643515 |
| *M. griseoroseus* | JO465 | Brazil | KJ173479 |
| *M. griseoroseus* var. *diminutus* | JO390 | Brazil | JX424044 |
| *M. guyanensis* | TYS314 | Thailand | EU935554 |
| *M. guyanensis* | NW280 | Thailand | EU935553 |
| *M. haediniformis* | DED 8216 | Sao Tome | KX953759 |
| *M. haediniformis* | DED 8217 | Sao Tome | KX953760 |
| *M. haematocephalus* | NW409 | Thailand | EU935527 |
| *M. haematocephalus* | NW296 | Thailand | EU935526 |
| *M. hinnuleus* | JES 217 | Madagascar | KX148988 |
| *M. hippiochaetes* | JO423 | Brazil | MN714025 |
| *M. hippiochaetes* | JO418 | Brazil | MN714024 |
| *M. horridulus* | INPA270735 | Brazil | KU170118 |
| *M. hypochroides* | NW405 | Thailand | EU935545 |
| *M. hypophaeus* | NW285 | Thailand | EU935484 |
| *M. imitarius* | CAL 1520 | India | MF189058 |
| *M. imitarius* | NW297 | Thailand | EU935496 |
| *M. indojasminodorus* | AKD 135/2015 | India | KY785172 |
| *M. insolitus* | LE 289497 | Russia | KF774162 |
| *M. insolitus* | LE 289498 | Russia | KF774163 |
| *M. inthanonensis* | NW353 | Thailand | EU935514 |
| *M.* cf. *iodactylus* | JO241 | Brazil | MN714026 |
| *M.* cf. *iodactylus* | JO110 | Brazil | MN714027 |
| *M. iras* | NW276 | Thailand | EU935486 |
| *M. jalapensis* | 414F | Paraguay | MT441867 |
| *M. jasminodorus* | NW294 | Thailand | EU935513 |
| *M. jasminodorus* | NW414 | Thailand | EU935515 |
| *M. jinfoshanensis* | DCY 2409 | China | MT556448 |
| *M. jinfoshanensis* | DCY 2413 | China | MT556449 |

**Table 1.** *Cont.*

| Taxa | Voucher | Locality | ITS |
|---|---|---|---|
| *M. katangensis* | JES 227 | Madagascar | KX148991 |
| *M. koreanus* | BRNM 714697 | Korea | FJ917619 |
| *M. koreanus* | BRNM 714700 | Korea | FJ917620 |
| *M. laranja* | DED 8231 | Sao Tome | KX953748 |
| *M. laticlavatus* | NW293 | Thailand | EU643512 |
| *M. laticlavatus* | NW412 | Thailand | EU643511 |
| *M. leoninus* | JO320 | Brazil | KP635162 |
| *M. leoninus* | JO84 | Brazil | KP635209 |
| *M. leucorotalis* | JO498 | Brazil | MN714039 |
| *M. leucorotalis* | JO448 | Brazil | MN714040 |
| *M. leveilleanus* | NW248 | Thailand | EU935566 |
| *M. leveilleanus* | NW268 | Thailand | EU935567 |
| *M. linderioides* | JO286 | Brazil | JX424037 |
| *M. longibasidiatus* | JO444 | Brazil | MN714050 |
| *M. longisetosus* | JO248 | Brazil | JX424040 |
| *M. luculentus* | CUH AM120 | India | KX138604 |
| *M. luteolus* | NW138 | Thailand | EU935506 |
| *M. luteolus* | NW304 | Thailand | EU935507 |
| *M. macrocystidiosus* | LE 295996 | Russia | KF774136 |
| *M. madagascariensis* | JES 225 | Madagascar | KX149006 |
| *M. madagascariensis* | JES 139 | Madagascar | KX149015 |
| *M. magnus* | ICN 179252 | Brazil | KX228848 |
| *M. magnus* | FLOR 55963 | Brazil | KX228846 |
| *M. makok* | NW201 | Thailand | EU935524 |
| *M. margallensis* | SIM35 | Pakistan | OP804130 |
| *M. margallensis* | SIM34 | Pakistan | OP804131 |
| *M. maximus* | BRNM 714570 | Korea | FJ904976 |
| *M. maximus* | BRNM 714571 | Korea | FJ904977 |
| *M. megistus* | JES 163 | Madagascar | KX148992 |
| *M. megistus* | Lockwood 2132155 | Madagascar | KX148993 |
| *M.* aff. *megistus* | DED 8230 | Sao Tome | KX953750 |
| *M. mokfaensis* | DED 7726 | Thailand | EU643516 |
| *M. mokfaensis* | NW020 | Thailand | EU643517 |
| *M. musicolor* | TYS417 | Malaysia | FJ431262 |
| *M. neosessilis* | SP 417480 | Brazil | JX424041 |
| *M. neotrichotus* | CTES0568167 | Argentina | MF683958 |
| *M. neotropicalis* | JO325 | Brazil | KP635185 |
| *M. neotropicalis* | JO69 | Brazil | KP635183 |
| *M. nigrobrunneus* | NW260 | Thailand | EU935574 |
| *M. nigrobrunneus* | NW120 | Thailand | EU935578 |
| *M. nigrodiscus* | Halling 9236 | USA | KF774137 |
| *M. nigrodiscus* | TENN 49976 | USA | KF774138 |
| *M. nivicola* | BRNM 714575 | Korea | FJ904972 |
| *M. nivicola* | BRNM 714572 | Korea | FJ904970 |
| *M. nodulocystis* | DED 8278 | Principe | KX953741 |
| *M. nodulocystis* | DED 8283 | Principe | KX953742 |
| *M. nummularius* | NW266 | Thailand | EU935492 |
| *M. nummularius* | NW396 | Thailand | EU935493 |
| *M. obscuroaurantiacus* | NW1079 | Thailand | MZ145165 |
| *M. occultatiformis* | VLA M-19639 | Russia | KF774160 |
| *M. occultatiformis* | LE 295995 | Russia | KF774157 |
| *M. occultatus* | BRNM 714699 | Korea | FJ917622 |
| *M. ochroleucus* | LE 295978 | Russia | KF912952 |
| *M. odoratus* | CAL 1264 | India | KT180332 |
| *M. oreades* | NN055694 | Denmark | JN943604 |
| *M. oreades* | ZRL2015086 | China | LT716048 |
| *M. orientalis* | BRNM 714913 | Korea | GU266262 |

**Table 1.** *Cont.*

| Taxa | Voucher | Locality | ITS |
|---|---|---|---|
| *M. olivascens* | TYS424 | Malaysia | FJ431266 |
| *M. olivascens* | TYS426 | Malaysia | FJ431265 |
| *M.* aff. *pallescens* | NW424 | Thailand | EU935500 |
| *M. pallidibrunneus* | MC 4706 | Brazil | KP635186 |
| *M. pallidoaurantiacus* | BKF 10248 | Thailand | MZ452673 |
| *M. pallidocinctus* var. *latisporus* | JO164 | Brazil | MN714053 |
| *M. pallidocinctus* var. *latisporus* | JO51 | Brazil | MN714054 |
| *M. paratrichotus* | DED 8248 | Sao Tome | KX953749 |
| *M. pellucidus* | NW321 | Thailand | EU935508 |
| *M. pellucidus* | NW342 | Thailand | EU935509 |
| ***M. pinicola*** | **Li20220706-13** | **China** | **OQ941785** |
| ***M. pinicola*** | **Li20220706-15 *** | **China** | **OQ941786** |
| *M. plicatulus* | NW439 | Thailand | EU935480 |
| *M. pseudoniveoaffinis* | JO60 | Brazil | KP635187 |
| *M. pseudoniveoaffinis* | JO70 | Brazil | KP635188 |
| *M. pseudopellucidus* | NW186 | Thailand | EU935504 |
| *M. pseudopellucidus* | NW305 | Thailand | EU935505 |
| *M. pseudopurpureostriatus* | NW286 | Thailand | EU643513 |
| *M. puerariae* | R. Kirschner & C.-J. Chen 2139 | China | JX470333 |
| *M. pulcherripes* | RA705-12b | USA | MK217466 |
| *M. pulcherripes* | iNAT:30809942 | USA | MZ267775 |
| *M. purpureisetosus* | NW155 | Thailand | EU935563 |
| *M. purpureobrunneolus* | NW370 | Thailand | EU935557 |
| *M. purpureobrunneolus* | NW215 | Thailand | EU935556 |
| *M. purpureostriatus* | BRNM 714566 | Korea | FJ904978 |
| *M. puttemansii* | JO249 | Brazil | MN714046 |
| *M. puttemansii* | JO120 | Brazil | MN714047 |
| *M. rhabarbarinus* | JO457 | Brazil | KP635191 |
| *M. rhabarbarinus* | JO474 | Brazil | KP642113 |
| *M. rhodopurpureus* | BRNM 724483 | Korea | HQ607382 |
| *M. rongklaensis* | NW555 | Thailand | KJ588401 |
| *M. rongklaensis* | NW767 | Thailand | EU935560 |
| *M. roseus* | JO352 | Brazil | ON502678 |
| *M. rotalis* | JES 145 | Madagascar | KX149000 |
| *M. rotalis* | JES 141 | Madagascar | KX148999 |
| *M. rotula* | ID PAN 279 | Poland | KM085384 |
| *M. rotula* | PBM 2563 | USA | DQ182506 |
| *M. rotula* | NN005958 | Denmark | JN943598 |
| *M. ruber* | DED 8669 | Brazil | KP635193 |
| *M. rubicundus* | JO464 | Brazil | ON502658 |
| *M. rubrobrunneus* | JES 191 | Madagascar | KX148989 |
| *M. ruforotula* | BRNM 714676 | Korea | FJ936152 |
| *M. ruforotula* | BRNM 714674 | Korea | FJ936150 |
| *M. sanguirotalis* | JO358 | Brazil | MN714060 |
| *M. siccus* | BRNM 552709 | Korea | HQ607384 |
| *M. siccus* | LE 295980 | Russia | KF774130 |
| *M. siccus* | DED 5255 | USA | FJ431272 |
| *M. silvicola* | JO362 | Brazil | KP635195 |
| *M. silvicola* | JO366 | Brazil | KP635196 |
| *M. somalomoensis* | JES 181 | Madagascar | KX149004 |
| *M. somalomoensis* | JES 165 | Madagascar | KX149003 |
| *M. sokola* | JES 154 | Madagascar | KX148994 |
| *M. spegazzinii* | JO467 | Brazil | KP635197 |
| *M. straminiceps* | NW256 | Thailand | EU935549 |
| *M. strobiluriformis* | BRNM 714914 | Korea | GU266263 |
| *M. strobiluriformis* | BRNM 714915 | Korea | GU266264 |

**Table 1.** *Cont.*

| Taxa | Voucher | Locality | ITS |
|---|---|---|---|
| *M. subarborescens* | DED 8215 | Sao Tome | KX953755 |
| *M. subputtemansii* | JO363 | Brazil | MN714043 |
| *M. subputtemansii* | JO54 | Brazil | MN714044 |
| *M. subruforotula* | NW140 | Thailand | EU935579 |
| *M.* cf. *subruforotula* | JES 186 | Madagascar | KX149017 |
| *M.* cf. *subruforotula* | JES 190 | Madagascar | KX149019 |
| *M. subtangerinus* | BRNM 718756 | Korea | HQ607380 |
| *M. subtropicus* | JIT14/2015 | India | MF189061 |
| *M. subtropicus* | AKD 51/2016 | India | MF189062 |
| *M. subvigintifolius* | JO242 | Brazil | MN714035 |
| *M. subvigintifolius* | JO220 | Brazil | MN714034 |
| *M. sullivantii* | MO218479 | USA | MK607492 |
| *M. suthepensis* | JO329 | Brazil | KP635198 |
| *M. suthepensis* | JO469 | Brazil | KP635199 |
| *M. tageticolor* | JBSD130776 | Dominican Republic | MT260146 |
| *M. tageticolor* | JBSD130775 | Dominican Republic | MT260147 |
| *M. tangerinus* | BKF 10249 | Thailand | MZ452087 |
| *M. tantulus* | NW239 | Thailand | EU935560 |
| *M. tenuissimus* | NW192 | Thailand | EU935568 |
| *M. tenuissimus* | NW199 | Thailand | EU935569 |
| *M. torquescens* | LE 234906 | Russia | KF774164 |
| *M. torquescens* | LE 247164 | Russia | KF774165 |
| *M. trichorhizus* | JO530 | Brazil | MN714051 |
| *M. trichotus* | NW262 | Thailand | EU935490 |
| *M. trichotus* | NW263 | Thailand | EU935491 |
| *M. tricystidiatus* | NR 100 | Argentina | MT441866 |
| *M. tricystidiatus* | CB T6-02 | Argentina | MF683959 |
| *M. trinitatis* | JO306 | Brazil | KP635200 |
| *M. tubulatus* | BRNM 714675 | Korea | FJ936151 |
| *M. tucumanus* | JBSD130778 | Dominican Republic | MT260145 |
| *M. venatifolius* | JO63 | Brazil | KP635201 |
| *M. venatifolius* | JO313 | Brazil | KP635203 |
| *M. vigintifolius* | JO112 | Brazil | MN714036 |
| *M. vigintifolius* | JO44 | Brazil | MN714037 |
| *M. wisteriae* | BRNM 724478 | Korea | JN003838 |
| *M. wisteriae* | BRNM 718761 | Korea | JN003839 |
| *M. wynneae* | HCCN G86 | Korea | FJ904979 |
| *M. xestocephalus* | JFK69 | Thailand | EU935488 |
| *M. xestocephalus* | NW344 | Thailand | EU935489 |
| *M. ypyrangensis* | JO472 | Brazil | MN714064 |
| *M. ypyrangensis* | JO374 | Brazil | MN714063 |
| *M. yunnanensis* | Dai 19857 | China | MW969679 |
| *M. yunnanensis* | Dai 19782 | China | MW969678 |
| *Marasmius* sp. 1 | Tu-BL11 | Japan | LC505316 |
| *Marasmius* sp. 2 | JO499 | Brazil | MN714059 |

The average standard deviation of split frequencies of BI was 0.008780 for the *Crinipellis* dataset at the end of the run. ML and BI analyses resulted in almost identical tree topologies compared to the MP analysis for this dataset. The MP tree of *Crinipellis* is shown in Figure 1, with the parsimony bootstrap values (≥50%, first value), likelihood bootstrap values (≥50%, second value), and Bayesian posterior probabilities (≥0.95, third value) labeled along the branches. The ML tree of *Marasmius* is shown in Figure 2, with the likelihood bootstrap values (≥50%) labelled along the branches. The information of each sample, including GenBank accession numbers, voucher specimens/strains, and locality, was listed together with the taxon name in the phylogenetic trees.

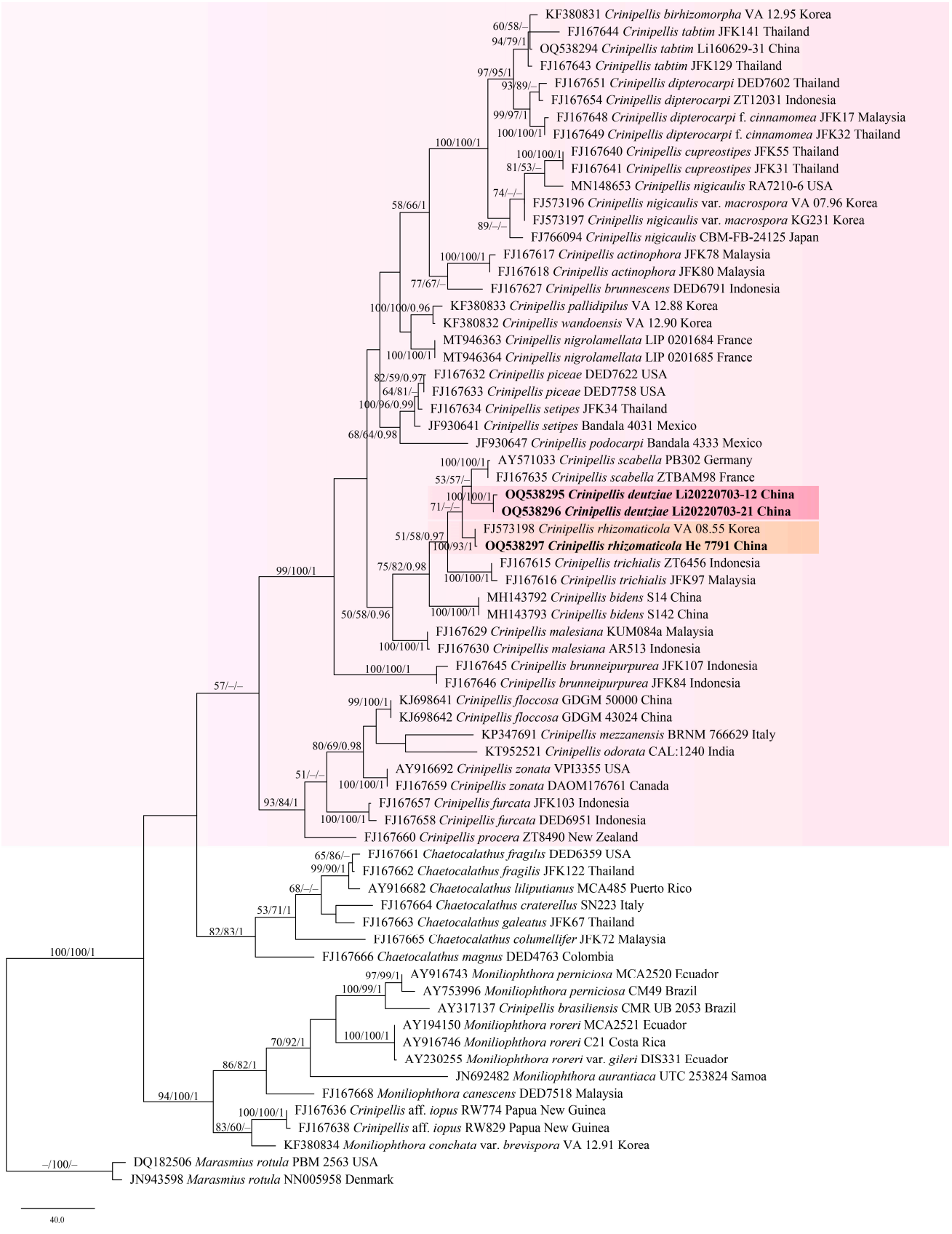


**Figure 1.** Maximum parsimony analysis tree of the ITS sequences of *Crinipellis* and related genera. Branches are labelled with parsimony bootstrap values (≥50%, first), likelihood bootstrap values (≥50%, second), and Bayesian posterior probabilities (≥0.95, third). New species (pink) and new Chinese records (orange) are highlighted and set in bold.

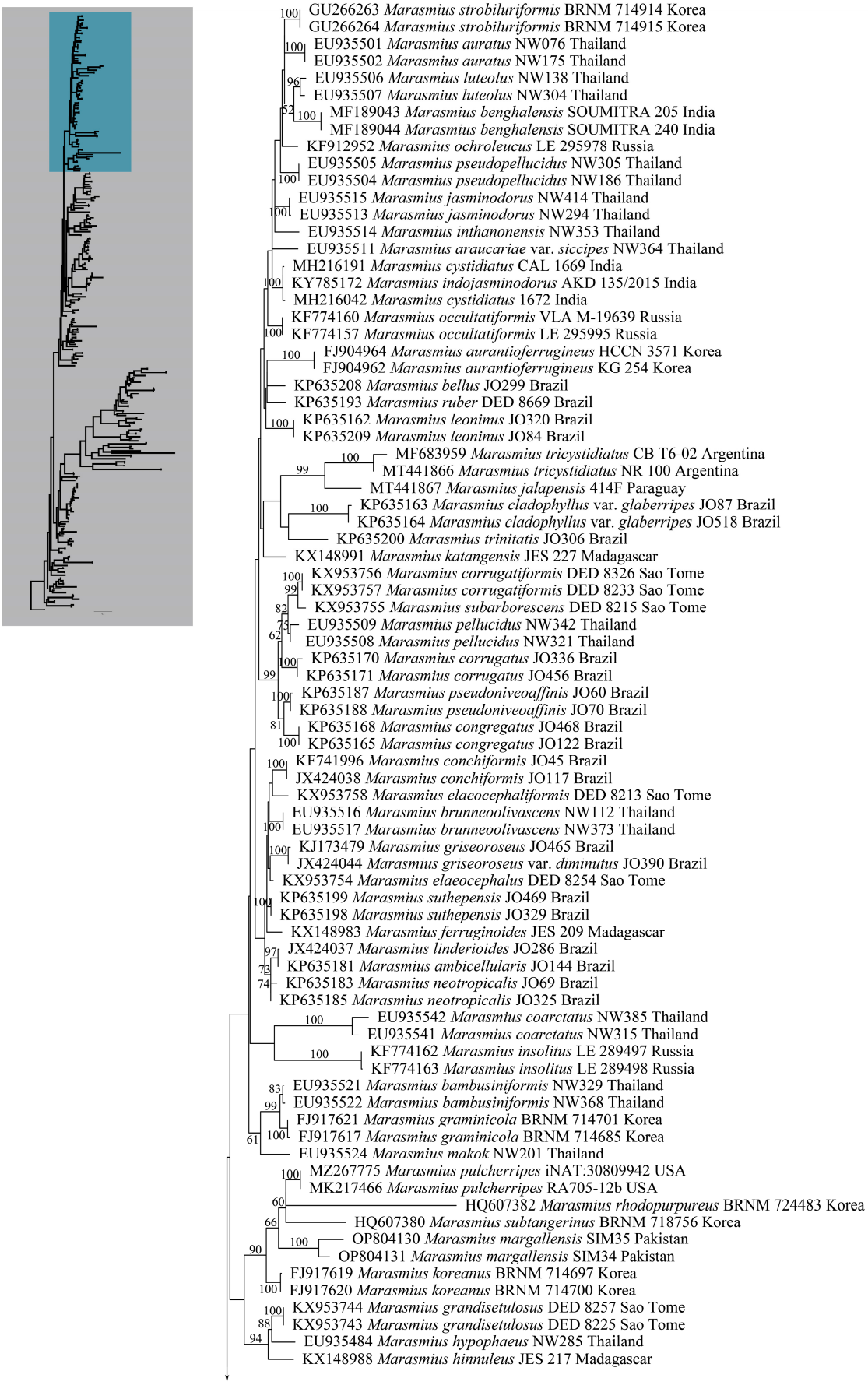


**Figure 2.** *Cont.*

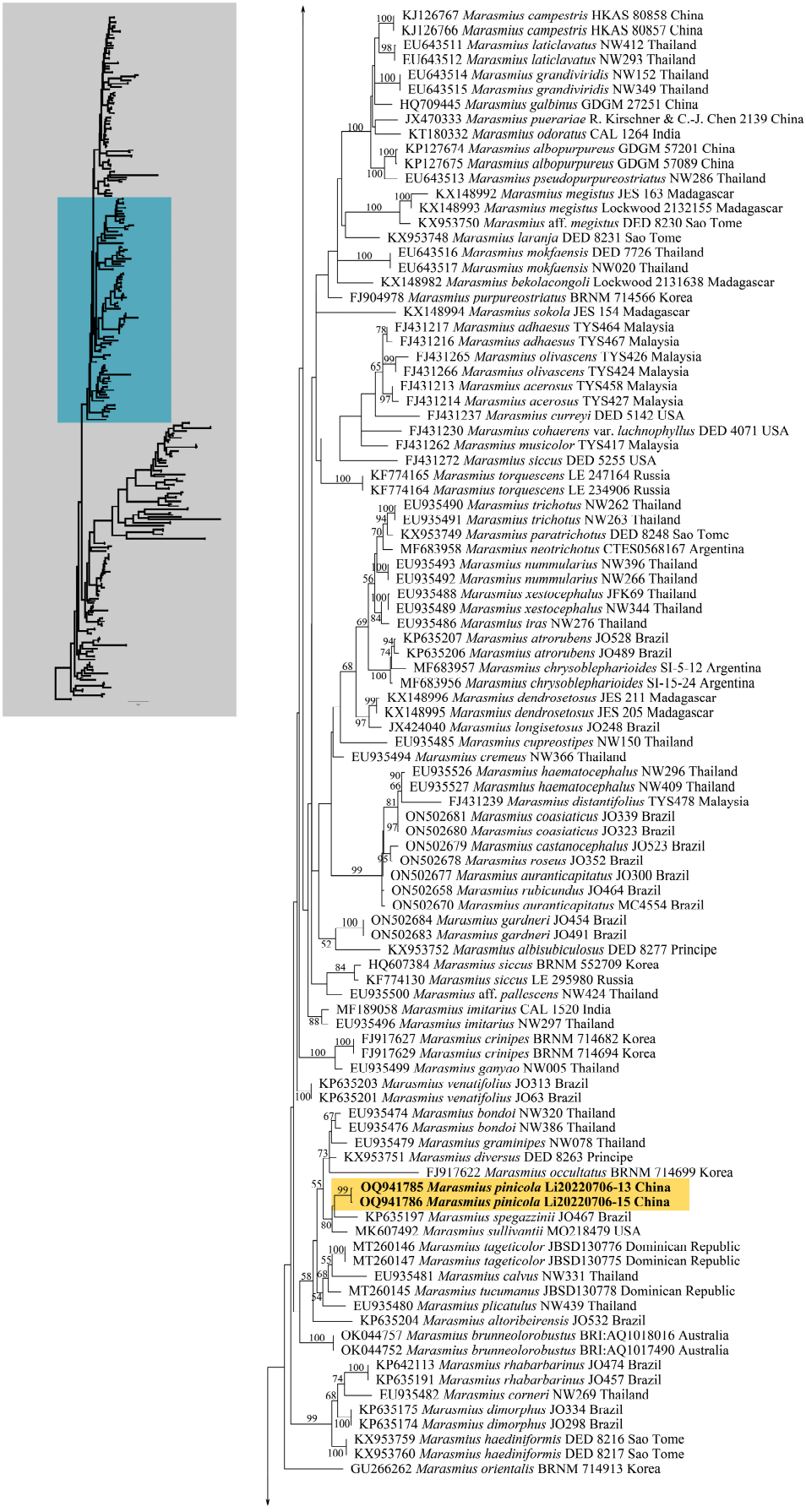


**Figure 2.** *Cont.*

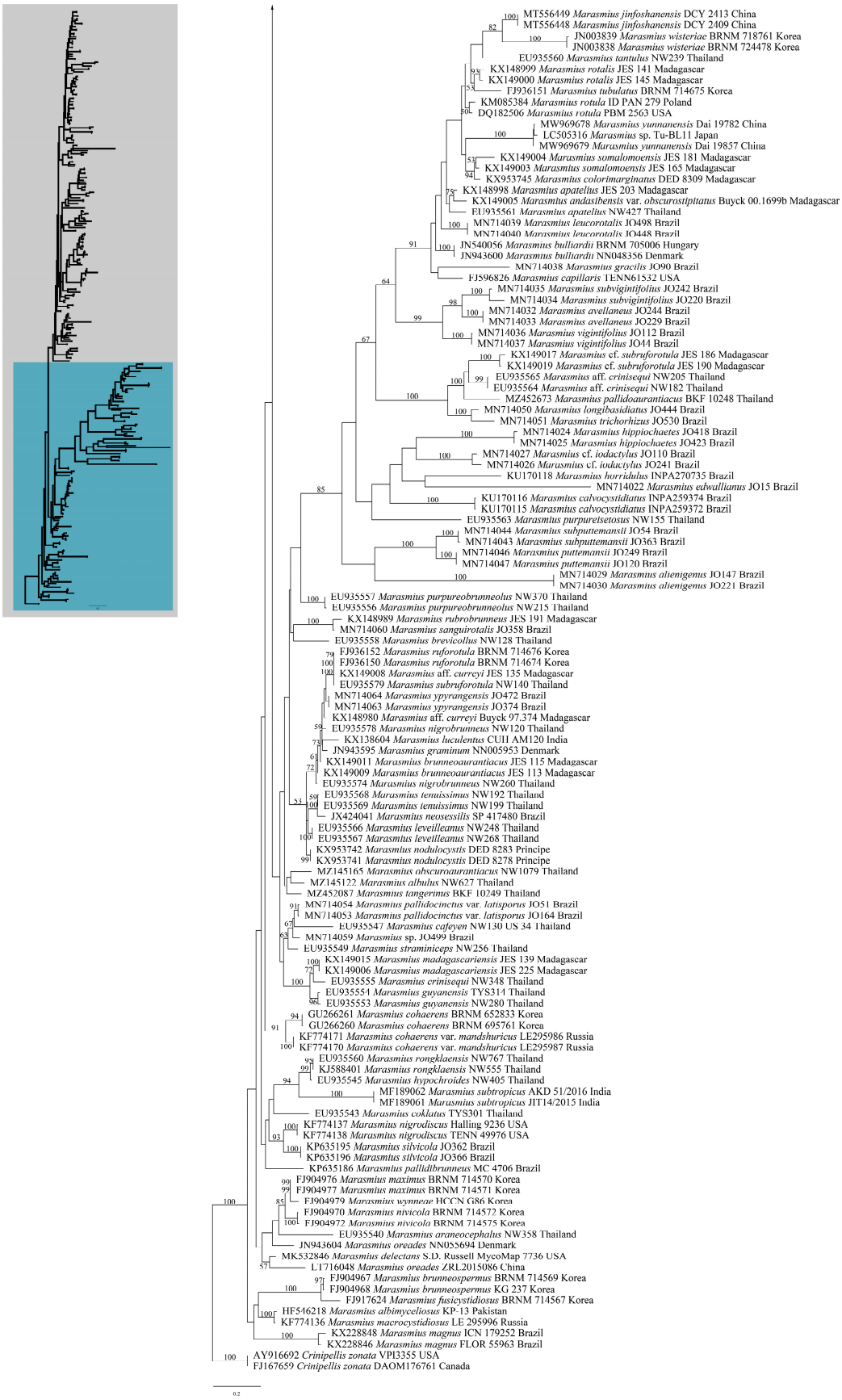


**Figure 2.** Maximum likelihood analysis tree of the ITS sequences of *Marasmius*. Branches are labelled with likelihood bootstrap values (≥50%). New species are set in bold and highlighted.

In the *Crinipellis* tree, *C. deutziae* formed a distinct lineage sister to *C. scabella*, while the two samples of *C. rhizomaticola* from China and Korea formed a strongly supported lineage. In the *Marasmius* tree, *M. pinicola* is sister to *M. spegazzinii* (Kuntze) Sacc. & P. Syd. and *M. sullivantii* Mont.

### 3.2. Taxonomy

***Crinipellis deutziae*** Jing Si, S.H. He & Hai J. Li, **sp. nov.** Figures 3 and 4.

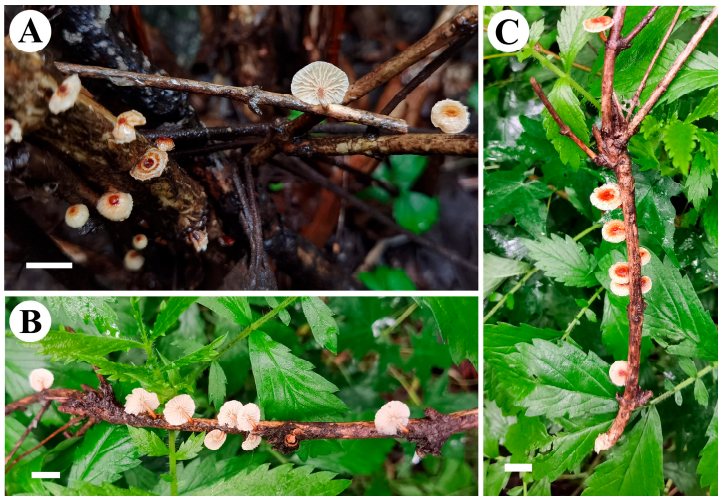


**Figure 3.** Basidiocarps of *Crinipellis deutziae* ((**A**–**C**) holotype, bars = 5 mm).

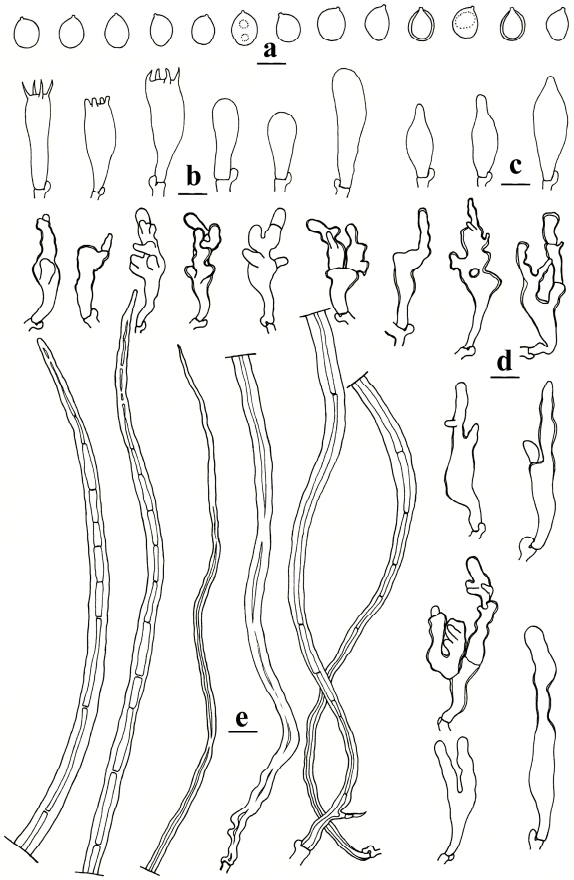


**Figure 4.** Microscopic structures of *Crinipellis deutziae* (Li20220703-12, holotype). (a) Basidiospores. (b) Basidia and basidioles. (c) Pleurocystidia. (d) Cheilocystidia. (e) Pileus hairs. Bars: a–e = 10 µm. Drawn by Hai-Jiao Li.

MycoBank: MB848969

Etymology: '*deutziae*' refers to the host tree of *Deutzia parviflora*.

Diagnosis: *Crinipellis deutziae* is characterized by small basidiocarps, cinnamon-buff, cinnamon, brownish orange, scarlet, brownish red to reddish brown at pileal disc, large, globose, subglobose, broadly ellipsoid, fusoid-ellipsoid to lacrimoid basidiospores, producing both cheilocystidia and pleurocystidia and gregarious on dead or living branch of *D. parviflora*.

Type: China. Beijing, Mentougou District, Xiaolongmen National Forest Park, alt: 1220 m, N: 39°57′32″ E: 115°25′38″, on a dead or living branch of *D. parviflora*, 3 July 2022, Li20220703-12 (Holotype). GenBank accession number for ITS: OQ538295.

Description: pileus 3–8 mm in diameter, campanulate when young, hemispherical to plane with age, umbilicate, distinctively zonate, with floccose squamules, cinnamon-buff, cinnamon, brownish orange, scarlet, brownish red to reddish brown at the disc, paler towards the margin, ash-grey to cream. Lamellae 0.5–2 mm broad, with 14–22 complete lamellae and 1–3 lamellulae between two complete lamellae, free, white to cream. Stipe 4–12 × 0.5–1 mm, cylindrical, equal, tomentose, insititious, cream to ash-grey at apex, through cinnamon-buff to brownish red towards base. No odor or taste.

Microstructure: basidiospores [170/4/3] (8−)8.8–11(−12.4) × (7−)7.5–9.5(−11) µm, L = 9.98 µm, W = 8.39 µm, Q = (1−)1.08–1.36(−1.43), Qm = 1.19 ± 0.09, hyaline, globose, subglobose, broadly ellipsoid, fusoid-ellipsoid to lacrimoid, mostly thin-walled, rarely thick-walled, smooth, IKI−, CB−. Basidia are clavate, with four sterigmata, 30–35 × 10–12 µm; basidioles are similar to basidia but slightly smaller. Cheilocystidia 32–84 × 8–10 µm, clavate, subcylindrical to irregular, mostly with one to several projections at the top, thin- to unevenly thick-walled, hyaline. Pleurocystidia rare, 24–36 × 9–11 µm, fusoid, thin-walled, hyaline. Pileipellis is a cutis of radially arranged, cylindrical or inflated, thin- to slightly thick-walled, IKI−, CB−, up to 12 µm wide hyphae. Pileus hairs 360–700 × 3–8 µm, hyaline in KOH, thick-walled, with acute or subacute apex, septate, strongly dextrinoid. Hyphae of pileus context 4–8 µm in diameter, hyaline, thin-walled, parallel, IKI−, CB−. Hyphae of lamellae and lamellulae trama 2.5–7 µm in diameter, hyaline, thin-walled, parallel, IKI−, CB−. Stipitipellis a layer of parallel hyphae, 3–7 µm in diameter, hyaline, thin-walled. Stipe hairs are similar to pileus hairs, 185–290 × 3–5 µm, hyaline in KOH, thick-walled, with acute or subacute apex, septate, and strongly dextrinoid. Clamp connections are present at all septa.

Habitat and distribution: gregarious on a dead or living branch of *D. parviflora*, at present only discovered in Beijing, China, in summer.

Additional specimens examined (paratypes): China. Beijing, Mentougou District, Xiaolongmen National Forest Park, alt: 1277 m, N: 39°57′29″ E: 115°25′27″, on dead or living branch of *D. parviflora*, 3 July 2022, Li20220703-21, GenBank accession number for ITS: OQ538296; the same location and habitat, alt: 1249 m, N: 39°57′30″ E: 115°25′27″, 3 July 2022, Li20220703-22.

Remarks: in the phylogenetic tree (Figure 1), *C. deutziae* formed a distinct lineage sister to *C. scabella* and *C. rhizomaticola*. *Crinipellis scabella* can be easily distinguished from *C. deutziae* because the basidiocarps rarely have bifurcate or trifurcate cheilocystidia [9]. *Crinipellis rhizomaticola* resembles *C. deutziae* by fusoid-ellipsoid to lacrimoid basidiospores (8.5–10 × 4–5 µm), clavate basidia (35 × 3–10 µm) and fusoid pleurocystidia (34–42 × 7.5–9.5 µm) but differs by larger basidiocarps (pileus 12–22 mm in diameter, stipe 40–60 × 0.75–1.25 mm), smaller cheilocystidia (17–32 × 4–7 µm), pileus hairs and stipe hairs that turn olive green in KOH [5]. *Crinipellis setipes* (Peck) Singer, described from northeastern North America [31], resembles *C. deutziae* in having a similarly sized pileus but differs in having smaller basidiospores (7–9 × 4–5 µm), basidia (16–24 × 4–6 µm), cheilocystidia (12–15 × 4–5 µm) and lacking pleurocystidia [1].

***Crinipellis rhizomaticola*** Antonín, R. Ryoo & H.D. Shin, Mycotaxon, 108: 433 (2009) (Figures 5 and 6).

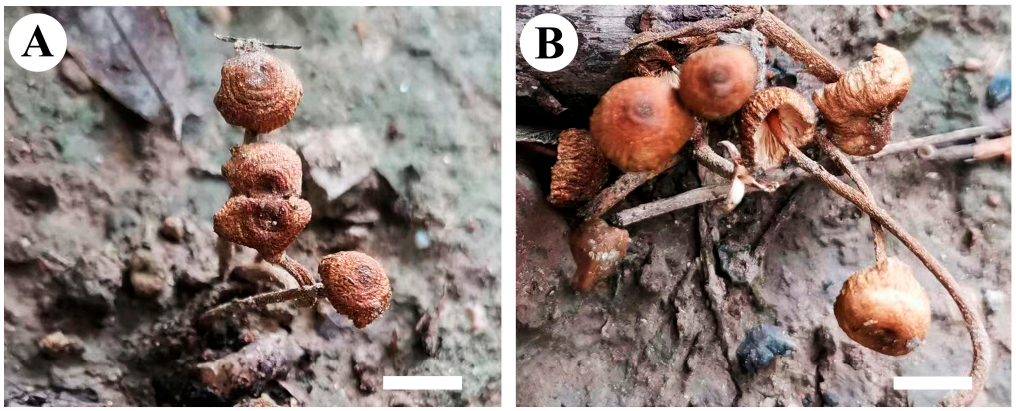


**Figure 5.** Basidiocarps of *Crinipellis rhizomaticola* ((**A**,**B**) He 7791, bar = 5 mm).

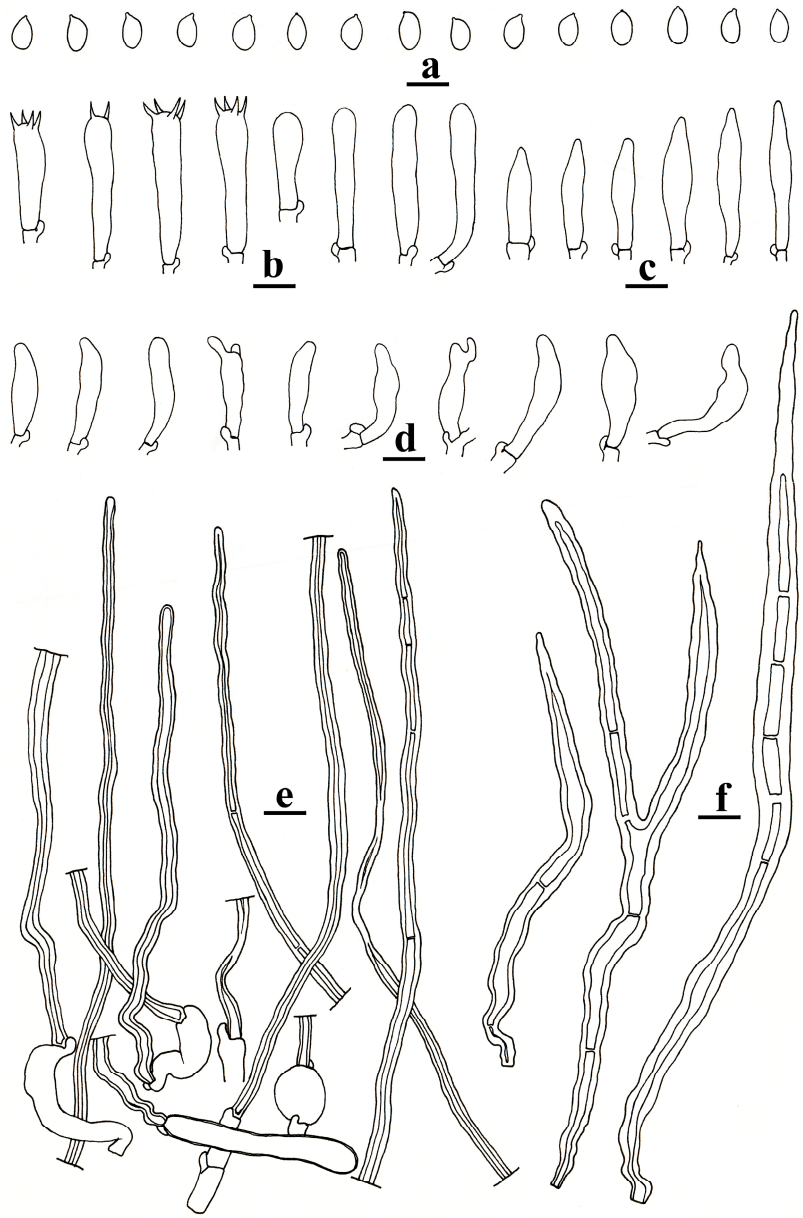


**Figure 6.** Microscopic structures of *Crinipellis rhizomaticola* (He 7791). (a) Basidiospores. (b) Basidia and basidioles. (c) Pleurocystidia. (d) Cheilocystidia. (e) Pileus hairs. (f) Stipe hairs. Bars: a–f = 10 μm. Drawn by Hai-Jiao Li.

Description: pileus 5–10 mm in diameter, conical to campanulate when young, convex-conical with age, umbilicate, with floccose squamules, orange-brown to reddish brown at the disc, paler towards the margin, brownish orange to orange-brown. Lamellae 0.5–1 mm broad, with 16–25 complete lamellae and 2–3 lamellulae between two complete lamellae, free, white to cream. Stipe 25–40 × 0.5–5 mm, cylindrical, slightly broadened at base, tomentose, insititious, longitudinally striate, pale brownish at apex, through brown to dark brown towards the base, entirely covered with hairs concolorous with pileus center or slightly paler. No odor or taste.

Microstructure:basidiospores [60/2/1] 7–9.2(−10) × (4−)4.5–5.7(−5.8) µm, L = 8.43 µm, W = 5.05 µm, Q = (1.4−)1.46–1.96(−2.07), Qm = 1.168 ± 0.15, hyaline, fusoid-ellipsoid to lacrimoid, thin-walled, smooth, IKI−, CB−. Basidia clavate to cylindrical, with four sterigmata, 28–37 × 7–8 µm; basidioles are similar to basidia, but slightly smaller. Cheilocystidia 23–35 × 5–8.5 µm, clavate, subcylindrical to fusoid, with one to two projections at the top, thin-walled, hyaline. Pleurocystidia 24–38 × 5–8 µm, fusoid, thin-walled, hyaline. Pileipellis is a cutis of radially arranged, cylindrical or inflated, thin- to slightly thick-walled, IKI−, CB−, pale ochraceous walls in KOH, 5–14 µm wide hyphae. Pileus hairs 120–600 × 3–7 µm, pale yellowish in $H_2O$, olivaceous in KOH, thick-walled, with acute or obtuse apex, septate, strongly dextrinoid. Hyphae of lamellae and lamellulae trama 4–8 µm in diameter, hyaline, thin-walled, parallel, IKI−, CB−. Stipitipellis a layer of parallel hyphae, 5–7 µm in diameter, pale yellowish in $H_2O$ and olivaceous in KOH thick-walled. Stipe hairs are similar to pileus hairs, 120–215 × 6–8 µm, pale yellowish in $H_2O$, olivaceous in KOH, thick-walled, with acute or subacute apex, septate, strongly dextrinoid. Clamp connections are present at all septa.

Habitat and distribution: gregarious on buried angiosperm branch, discovered in Beijing, China, and its type locality, Republic of Korea, in summer.

Specimen examined: China. Beijing, Haidian District, Olympic Forest Park, on the ground, 28 July 2020, He 7791 (BJFC038936), GenBank accession number for ITS: OQ538297.

Remarks: when compared to the type description, the Chinese collection has slightly shorter and wider basidiospores (7–9.2 × 4.5–5.7 µm vs. 8.5–10 × 4–5 µm, [5]), cheilocystidia with fewer projections, fusoid pleurocystidia, and shorter stipe hairs [5]. In the phylogenetic tree (Figure 1), the Chinese sample (He 7791) and the type specimen (VA 08.55 or BRNM712570) of the species formed a strongly supported lineage.

***Marasmius pinicola*** Jing Si, S.H. He & Hai J. Li, **sp. nov.** Figures 7 and 8.

**Figure 7.** Basidiocarps of *Marasmius pinicola* (bar = 2 cm).

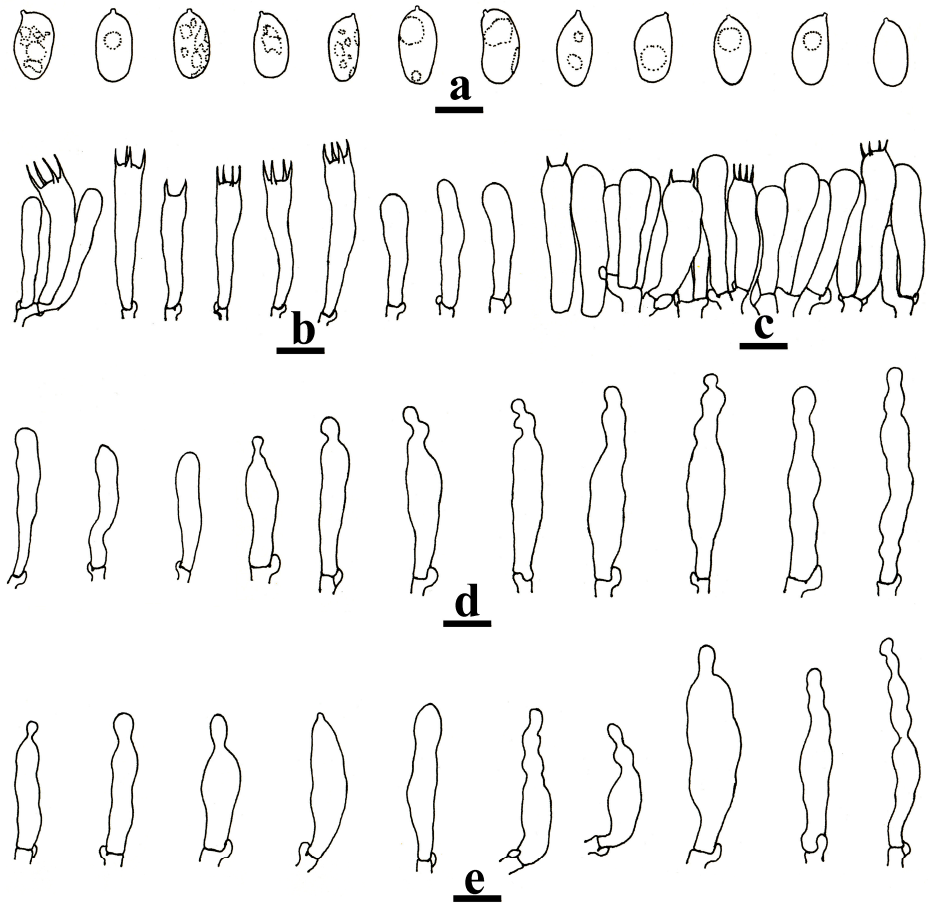


**Figure 8.** Microscopic structures of *Marasmius pinicola* (Li20220706-15). (a) Basidiospores. (b) Basidia and basidioles. (c) Pileipellis. (d) Cheilocystidia. (e) Pleurocystidia. Bars: a = 5 μm, b–e = 10 μm. Drawn by Hai-Jiao Li.

MycoBank: MB848970

Etymology: '*pinicola*' refers to the host tree of *Pinus tabuliformis*.

Diagnosis: *Marasmius pinicola* is characterized by small basidiocarps, pileal surface yellowish brown to cinnamon when young, yellowish brown, cinnamon to orange-brown at the center, and pale brownish to almost white towards margin with age, cylindrical, reniform to phaseoliform basidiospores, often capitate cheilocystidia and pleurocystidia, hymeniform pileipellis with basidia scattered within, and growing on fallen leaves of *P. tabuliformis*.

Type: China. Beijing, Dongcheng District, Temple of Heaven, alt: 40 m, N: 39°52′41″ E: 116°24′29″ , on decayed leaf litter of *P. tabuliformis*, 6 July 2022, Li20220706-15 (Holotype). GenBank accession number for ITS: OQ941786.

Description: pileus 10–40 mm in diameter, hemispherical, convex-conical with broad, obtuse umbo and inflexed margin when young, then plano-convex to applanate with slightly undulate margin and low obtuse central umbo, center smooth or slightly rugulose, glabrous, crenulate at margin, dry, yellowish brown to cinnamon when young, yellowish brown, cinnamon to orange-brown at center with age, paler towards margin, pale brownish to almost white. Lamellae 1–4 mm broad, with 20–28 complete lamellae and 2–3 lamellulae between two complete lamellae, free, white to cream. Stipe 20–55 × 1–4 mm, cylindrical, equal or slightly swollen at base, pruinose all over, rarely twisted, base white tomentose, surface dull, dry, tough-elastic, cream to buff at apex, through pinkish-buff to cinnamon-buff towards the base. No odor or taste.

Microstructure: basidiospores [80/3/2] 6–8 × 3.5–4.2(−4.8) μm, L = 6.92 μm, W = 3.93 μm, Q = (1.46−)1.56–2(−2.06), Qm = 1.77 ± 0.13, hyaline, cylindrical, reni-

form to phaseoliform, thin-walled, smooth, IKI−, CB−. Basidia clavate, mostly with four sterigmata, rarely with two sterigmata, 19–34 × 5–7 μm; basidioles are similar to basidia, but slightly smaller. Cheilocystidia 28–40 × 5–8 μm, clavate, versiform, clavate, subfusoid to subcylindrical, ventricose or with 1–4 constrictions near the apex, which is narrower and somewhat monilioid, or only capitate to mucronate, thin-walled, hyaline. Pleurocystidia scattered, 26–46 × 5–12 μm, similar to cheilocystidia. Pileipellis hymeniform, with 2- or 4-spored basidia scattered, 25–30 × 5–9 μm, clavate, hyaline, thin-walled, IKI−, CB−. Hyphae of pileus context 5–15 μm in diameter, hyaline, thin-walled, interwoven, dextrinoid, CB−. Hyphae of lamellar trama 6–19 μm in diameter, hyaline, thin-walled, parallel, dextrinoid, CB−. Stipitipellis a layer of parallel hyphae, 3–8.5 μm in diameter, hyaline to yellowish, thin- to thick-walled, IKI−, CB−. Clamp connections are present at all septa.

Habitat and distribution: scattered to gregarious on decayed leaf litter of *P. tabuliformis*, at present only discovered in Beijing, China, in summer.

Additional specimens examined (paratypes): China. Beijing, Dongcheng District, Temple of Heaven, alt: 40 m, N: 39°52′41″ E: 116°24′29″, on decayed leaf litter of *P. tabuliformis*, 6 July 2022, Li20220706-13. GenBank accession number for ITS: OQ941785.

Remarks: morphologically, *M. pinicola* matches well with the concept of section *Globulares* [16,32–34]. *Marasmius oreades* (Bolton) Fr. and *M. nivicola* Har. Takah. share similar small basidiocarps and similar-sized basidiospores (6–9 × 4–5 μm for *M. oreades*, 6–8 × 3–4 μm for *M. nivicola*) with *M. pinicola* but can be easily distinguished by the absence of pleurocystidia [35,36]. In the phylogenetic tree (Figure 2), *M. pinicola* formed a distinct lineage sister to *M. spegazzinii*, which is similar to *M. pinicola* by sharing the brown pileal surface and cylindrical basidiospores but differs in having larger basidiocarps (pileus 21–45 mm in diameter, stipe 46–85 × 1.5–4 mm), larger basidiospores (7.5–11.3 × 2.5–3.5 μm), and smaller cheilocystidia (11.3–22.5 × 6.3–10 μm, [34]). The ITS sequence similarity between *M. pinicola* (OQ941785) and *M. spegazzinii* (KP635197) is 90.91%, and there are 60 base pair differences, including gaps between the two sequences.

## 4. Discussion

The Marasmiaceae includes about ten genera, viz. *Amyloflagellula* Singer, *Brunneocorticium* Sheng H. Wu, *Campanella* Henn., *Chaetocalathus*, *Crinipellis*, *Hymenogloea* Pat., *Marasmius*, *Moniliophthora*, *Neocampanella* Nakasone, Hibbett & Goranova, and *Tetrapyrgos* E. Horak [37,38]. Among them, *Brunneocorticium* and *Neocampanella* are newly described corticioid fungi with strictly resupinate basidiocarps based on molecular data [37]. However, the mushroom genera *Collybia* (Fr.) Staude, *Gymnopus* (Pers.) Gray, *Marasmiellus* Murrill, and *Mycena* (Pers.) Roussel that are morphologically similar to *Marasmius* are not nested within the Marasmiaceae in phylogeny.

The species of *Marasmius* sensu lato are commonly found on leaves, and wood debris in forest litter, and numerous species were described under the genus. Although many species have been transferred to many other genera, the infrageneric classification of *Marasmius* sensu stricto is still unclear [14]. The ITS sequences are very helpful for species-level investigations, and many cryptic species were discovered based on a single gene. However, other loci, especially the protein-coding genes, should be used in future studies in order to resolve the phylogeny of *Marasmius* s.s. and its related genera.

## 5. Conclusions

The present study reveals two new species and a new Chinese record of Marasmiaceae from Beijing based on molecular and morphological evidence. It is a part of the comprehensive study of macro-fungi diversity in Beijing, which was poorly studied and only drew the intensive attention of some mycologists in recent years [20–26]. Many new taxa from this area will be found in future studies, with more and more specimens of some large, under-studied groups being collected and sequenced. Our study also shows that plant hosts are important in the identification of fungi, even when they are saprotrophic. Coevolution between fungi and host plants might commonly occur in the history of evolution.

**Author Contributions:** Conceptualization, S.-H.H., J.S. and H.-J.L.; methodology, S.-H.H., J.S. and H.-J.L.; software, Y.L., S.-H.H. and H.-J.L.; validation, Y.-Z.Z., J.-Q.L., W.-Y.S., Y.L., S.-H.H., J.S. and H.-J.L.; formal analysis, Y.L.; investigation, Y.L., S.-H.H., Y.-Z.Z., J.-Q.L., W.-Y.S., J.S. and H.-J.L.; resources, S.-H.H. and H.-J.L.; data curation, Y.L., S.-H.H., J.S. and H.-J.L.; writing—original draft preparation, Y.L., S.-H.H. and H.-J.L.; writing—review and editing, S.-H.H., J.S. and H.-J.L.; visualization, Y.-Z.Z. and J.-Q.L.; supervision, S.-H.H., J.S. and H.-J.L.; project administration, S.-H.H., J.S. and H.-J.L.; funding acquisition, S.-H.H., J.S. and H.-J.L. All authors have read and agreed to the published version of the manuscript.

**Funding:** The research was financed by the National Natural Science Foundation of China (Nos. 32070005, 32270021, and 32070016).

**Data Availability Statement:** Not applicable.

**Conflicts of Interest:** The authors declare no conflict of interest.

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