

New *Clavulina* species from the Pakaraima Mountains of Guyana

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Five new species of *Clavulina* (Clavulinaceae, Cantharellales, Basidiomycota) are described from the Pakaraima Mountains of Guyana, occurring in rain forests dominated by the ectomycorrhizal tree *Dicymbe corymbosa* (Caesalpinaceae). These clavarioid fungi have simple (i.e., unbranching) basidiomata, which is a relatively uncommon phenotypic feature for the genus *Clavulina*. Macromorphological, micromorphological, and habitat data are provided for each taxon, and nuclear ribosomal DNA sequences of the 28S subunit and internal transcribed spacer region were obtained for each holotype collection.

Taxonomic novelties: *Clavulina caespitosa* Henkel, Meszaros et Aime, *Clavulina dicymbetorum* Henkel, Meszaros et Aime, *Clavulina humicola* Henkel, Meszaros et Aime, *Clavulina griseohumicola* Henkel, Meszaros et Aime, and *Clavulina monodiminutiva* Henkel, Meszaros et Aime

Keywords: coral fungi, ectomycorrhiza, Guiana Shield, Neotropics, systematics

Species of *Clavulina* Schroet. (Clavulinaceae, Cantharellales, Basidiomycota) form a conspicuous component of the macromycota associated with the ectomycorrhizal (EM) tree *Dicymbe corymbosa* Spruce ex Benth. (Caesalpinaceae, tribe *Amherstieae*) in the primary rain forests of Guyana's Pakaraima Mountains (HENKEL, TERBORGH & VILGALYS 2002; THACKER & HENKEL 2004). Ectomycorrhizal fungi fruit prolifically during the May–July rainy season in *D. corymbosa*-dominated forests, while remaining largely absent from the surrounding mixed forest matrix composed primarily of arbuscular-mycorrhizal trees. Eight years of collecting in this region have uncovered approximately 150 morpho-species of putatively EM fungi, many of which represent new species and genera (e.g. HENKEL 1999; HENKEL, AIME & MILLER 2000, MILLER et al. 2001, SIMMONS, HENKEL & BAS 2001, MILLER, AIME & HENKEL 2002, MATHENY, AIME & HENKEL 2003) while most still await formal description. At least 20 of these morphospecies belong to the genus *Clavulina*, a significant number considering that only 47 species have been described in the genus worldwide (CORNER 1950, 1970; PETERSEN 1983, 1985, 1988a, 1988b; ROBERTS 1999, THIND & SHARDA 1984). These *Clavulina* taxa are spatially restricted to groves of *D. corymbosa* and presumed to be ectomycorrhizal (THACKER, HENKEL & VILGALYS 2001; HENKEL, AIME & S.L. MILLER, unpubl.). Several of these *Clavulina* taxa are highly prized as food by the Patamona Amerindians (HENKEL

et al. 2004). Some members of the Guyanese *Clavulina* assemblage deviate from the phenotypic features typically used to delimit the genus, including the presence of coralloid basidiomata and bisterigmate basidia, although molecular data support their placement in *Clavulina* (THACKER & HENKEL 2004; AIME, HENKEL & KENNEDY, unpubl.). Additionally, Guyanese *Clavulina* species appear uniformly lacking in hymenial cystidia, a phenotypic feature characterizing many subtropical and tropical *Clavulina* taxa described elsewhere (CORNER 1950, 1970; PETERSEN 1983, 1985, 1988a). The functional basis for this discrepancy is currently unknown.

Basidiomata that are simple or sparsely-branched at maturity are infrequently encountered in *Clavulina*, being recorded in a few species from Southeast Asian rain forests and Australasia (CORNER 1950, 1970; PETERSEN 1983, 1985, 1988a). Here we describe five new species of *Clavulina* from Guyana with simple basidiomata, i.e., *C. caespitosa*, *C. dicymbetorum*, *C. humicola*, *C. griseohumicola*, and *C. monodiminutiva*.

Material and methods

Collections. Collections were made during the May–July rainy seasons of 2000–2004 from the Upper Potaro River Basin, within a 5 km radius of a permanent base camp at 5° 18' 04.8" N; 59° 54' 40.4" W; elevation 710 m. The site was located in an undulating valley approximately 20 km east of Mt. Ayanganna, and was densely forested with a mosaic of primary *Dicymbe*-dominated and mixed forests of the *Eschweilera-Licania* association (FANSHAW 1952; further site details: HENKEL 2003). All fungi were collected from forests dominated by *D. corymbosa*. Macroscopic features were described fresh in the field. Colors were described subjectively and coded according to KORNERUP & WANSCHER (1978), with

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color plates noted in parentheses. Macrochemical tests were performed according to the methods of SINGER (1986). Fungi were field-dried with silica gel (MILLER, AIME & HENKEL 2002).

Micromorphological features of fresh specimens were examined with an EPOI field microscope with light optics; dried specimens were examined with an Olympus BX51 microscope with light and phase contrast optics. For basidiospores, basidia, and other structures at least 20 individuals were measured. Rehydrated fungal tissue was mounted in H₂O, 3% KOH, and Melzer's solution. Line drawings were made using a drawing tube. Specimens were deposited in the following herbaria (HOLMGREN, HOLMGREN & BARNETT 1990): BRG – University of Guyana; HSU – Humboldt State University; and BPI – U.S. National Fungus Collections.

DNA extraction. For some specimens, field tissue samples were taken and stored in 2X CTAB and subsequently extracted by one of the following methods: (1) the tissue was removed with sterile forceps, rinsed with sterile H₂O and extracted with the UltraClean Plant DNA Isolation Kit as per the manufacturer's instructions (MoBio Laboratories, Inc., Solana Beach, CA); (2) the tissue was removed with sterile forceps, rinsed with sterile H₂O, and placed in 600 µL of Nuclei Lysis Solution from the Wizard Genomic DNA Purification Kit, and extracted as per the manufacturer's instructions (Promega Corp., Madison, WI). Material obtained from previously dried field collections was extracted with the UltraClean Plant DNA Isolation Kit (MoBio Laboratories, Inc., Solana Beach, CA). Extractions with evidence of co-extracted fungal pigments or polysaccharides were cleaned with the GeneClean Spin kit, following the manufacturer's protocol (Qbiogene, Inc., Irvine, CA).

Polymerase chain reactions (PCR) and cycle sequencing.

Two regions of the nuclear ribosomal DNA were sequenced from holotype collections (only one region was sequenced for *C. griseohumicola*). The internal transcribed spacer region (ITS) was amplified with primers ITS1-F and ITS4-B (GARDES & BRUNS 1993); 28S large subunit sequences (28S) were amplified with primers LROR and LR6 (primers developed by the Mycology Lab of Duke University, <http://www.biology.duke.edu/fungi/mycolab/primers.htm>). All PCRs were performed in 25 BL reaction volumes with 12.5 µL of PCR Master Mix (Promega Corp., Madison, WI), 1.25 µL each of 10 µM primers and 10 µL of diluted (10- to 100-fold) DNA template. Amplification was achieved with an initial denaturation step of 5 min at 94 °C; 35 cycles of 30 sec at 94 °C, 45 sec at 50 °C, and 45 sec at 72 °C; and a final extension of 7 min at 72 °C. PCR products were cleaned by one of two methods: (1) the majority were cleaned with Montage PCR Centrifugal Filter Devices (Millipore Corp., Billerica, MA) following the manufacturer's protocol; if more than one PCR product was produced during amplification, then the band of the correct size was excised from a 1% agarose gel and cleaned with the MinElute PCR Gel Extraction Kit (Qiagen, Inc.,

Valencia, CA). Cleaned PCR products were sequenced with BigDye Terminator sequencing enzyme v.3.1 (Applied Biosystems, Foster City, CA) and primers ITS1-F and ITS4-B (ITS) or LR0R, LR3R, LR5 and LR6 (28S) in the following reaction: 2 BL of diluted BigDye in a 1:3 or 1:1 dilution of BigDye:dilution buffer (400 mM Tris pH8.0, 10 mM MgCl₂); 0.3 µL of 10 BM primer; 10–20 ng of cleaned PCR template; and H₂O to 5 µL total reaction volume. Cycle sequencing parameters consisted of a 2 min denaturation step at 94 °C, then 35 cycles of 94 °C for 39 sec, 50 °C for 15 sec, and 60 °C for 4 min. Sequencing reactions were cleaned by ethanol precipitation and sequenced on an ABI 3100 Genetic Analyzer (Applied Biosystems, Foster City, CA). All DNA sequences have been deposited in GenBank (accession numbers DQ056364–DQ056372). Sequences were confirmed as *Clavulina* by BLAST (<http://www.ncbi.nlm.nih.gov/BLAST/>).

Taxonomy

Clavulina caespitosa Henkel, Meszaros et Aime sp. nov.

Figs. 1–2

Latin diagnosis: *Clavulinae rugosae* (Fr.) Schroet., ex regionibus borealibus temperatis, amplitudine, hymenii colore, et habitu similis, sed inter alia aeneo stipite, laevi maturo hymenio, parvioribus (8.5–10.5 × 7–9.5 µm) sporis, et longioribus (81–98 µm) basidiis differt.

Basidiomata simple, in caespitose clusters, free or slightly fused basally, with numerous acuminate basal primordia (Fig. 1), rarely occurring singly; entire clusters 77–196 (247) × 40–77 mm; individual basidiomata 68–167 (310) × 2–5 (16) mm (centrally), simple, rarely branching dichotomously 1–3 times, cylindrical, apex sharply acuminate. Hymenium 54–130 (243) × 4–8 (16) mm (centrally), when immature brown (5C5–5C6), ripening first to flesh cream (5B3–5B4) then to dirty grayish cream (5B3–5C3), darkening slightly with age, thickening substantially over entire distal portion, eventually obscuring apical tip, rarely flattening and canaliculate with age, smooth, moist; juncture with stipe abrupt, occasionally irregular. Stipe 26–70 (98) × 2–4 mm (centrally), tapering slightly toward base, bronze-brown (5D5–5D6) when young, darkening to 6F7 with age, smooth throughout, slightly curving, basal mycelium wanting; context tough, pliant. In transverse section context concolorous with stipe, unchanging, 2.5–6.0 mm thick, solid initially, becoming hollow centrally with age; hymenium concolorous, 0.5–1.0 mm thick, with several narrow concentric rings with age. Odor minimal, mildly fungoid; taste mild, slightly mealy. Macrochemical reactions: FeSO₄, KOH, and NH₄OH nil all tissues. Spore deposit white.

Basidiospores 8.5–10.5 (12) × 7–9.5 µm (mean Q = 1.19), subglobose, smooth, hyaline, inamyloid, with numerous opaque guttules of various sizes; hilar appendix minute, 0.25–0.5 µm long (Fig. 2). Basidia 81–98 µm long, width at apex 6.3–7.5 µm, at base 3.5–5 µm, subcylindrical, tapering evenly toward base, gloeoporous; post-partial septa not observed (Fig. 2); sterigmata 6.3–7.5 µm long, 2.5 µm wide at base, cornute, 2 (rarely 3) per basidium. Basidioles numerous. Cystidia none. Unin-

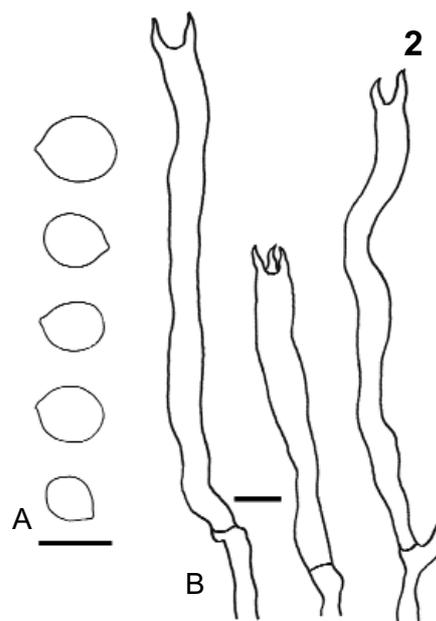


Fig. 1: Basidiomata of *Clavulina caespitosa* (holotype, Henkel 8709). Scale bar = 10 mm. – **Fig. 2:** Microscopic features of *Clavulina caespitosa* (holotype, Henkel 8709). Scale bars = 10 μ m. A. Basidiospores. B. Basidia.

flated tramal hyphae 3.8–8.8 μ m wide, smooth, thin-walled, hyaline, lacking internal contents. Inflated tramal hyphae up to 31 μ m wide, smooth, hyaline. Clamp connections abundant.

Etymology. Caespitosa, Latin, referring to the distinctly caespitose habit.

Habit, habitat, and distribution. Scattered to occasionally gregarious in caespitose clusters, or rarely singly, on mineral earth beneath root mat in rain forests dominated by *Dicymbe corymbosa*; commonly encountered throughout the May–July rainy season and less frequently in the December–January rainy season; basidiomata resistant to decay, persisting for several weeks. Known from the type locality in the Upper Potaro Basin, as well as the Upper Ireng Basin, Guyana.

Specimens examined. GUYANA. Region 8, Potaro-Siparuni: Pakaraima Mountains. Upper Potaro River Basin, vicinity of base camp located near confluence with Whitewater Creek, ~20 km east of Mt. Ayanganna: 4 km southeast of base camp, 750 m elevation, under *D. corymbosa*, 28 VI 2004, Henkel 8709 (HOLOTYPE: BRG; ISOTYPE: HSU; GenBank accession: DQ056370 [28S]; DQ056371 [ITS]); 0.5 km east of base camp, 710 m elevation, under *D. corymbosa*, 24 VI 2002, Henkel 8496 (BRG; HSU); 0.5 km east of base camp, 710 m elevation, under *D. corymbosa*, 21 VI 2001, Henkel 8340 (BRG; HSU); 4 km southwest of base camp, 720 m elevation, under *D. corymbosa*, 30 V 2001, Henkel 8225 (BRG; HSU); near base camp, 650 m elevation, under *D. corymbosa*, 28 V 2000, Aime 1060 (BRG; BPI).

Commentary. *Clavulina caespitosa* is recognized in the field by its large, simple basidiomata with cream-colored hyme-

nium occurring in scattered caespitose clusters, these arising from mineral earth in groves of *Dicymbe* trees. This species is somewhat similar in size, hymenium color, and habit to varieties of *Clavulina rugosa* (Fr.) Schroet. (CORNER 1950, 1970). However, *C. rugosa* lacks the bronze stipe of *C. caespitosa*, has a decidedly rugulose hymenium at maturity, larger, ovoid-ellipsoid spores (9–14 \times 8–12 μ m), and shorter basidia (40–85 μ m). Additionally, *C. rugosa* appears to be predominantly temperate in distribution (but see CORNER 1970). While lacking post-partial basidial septa, *C. caespitosa* otherwise has a number of phenotypic features common to the genus, including inflated and clamped tramal hyphae, cylindrical, elongated, bisterigmate basidia, and cornute sterigmata (CORNER 1970, PETERSEN 1983). Sequence data from both the 28S and ITS confirm the generic placement of *C. caespitosa*, and its genetic distinctiveness from the phenotypically-similar *C. dicymbetorum*, described below.

Clavulina dicymbetorum Henkel, Meszaros et Aime sp. nov. **Figs. 3–4**

Latin diagnosis: *Clavulinae caespitosae* Henkel, Meszaros & Aime, amplis persistentibus simplicibus basidiomatibus similis, sed inter alia leviter parvioribus (8–9.5 \times 7–8 μ m) basidiosporis, brevioribus (62–79 μ m) basidiis pro parte maxime nimis septatis habentibus, purpureo-brunneo stipite, et solitario fructifero habitu differt.

Basidiomata simple and occurring singly, or rarely in clusters of 2–4 and then not fused basally, 56–100 (160) \times 3–6 (10) mm (centrally), cylindrical with rounded-acuminate apex, very

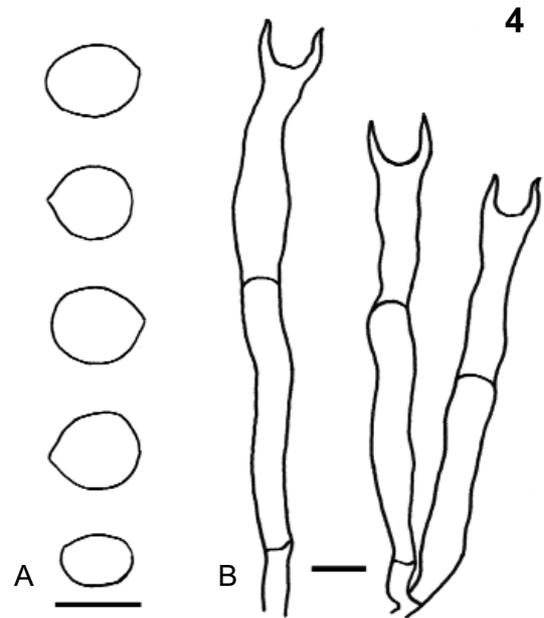


Fig. 3: Basidiomata of *Clavulina dicymbetorum* (holotype, Henkel 8730). Scale bar = 10 mm. – **Fig. 4:** Microscopic features of *Clavulina dicymbetorum* (holotype, Henkel 8730). Scale bars = 10 μ m. A. Basidiospores. B. Basidia.

rarely with 1–2 short apical branches; base occasionally with 1–2 short acuminate primordia (Fig. 3). Hymenium 40–75 \times 3–6 (10) mm (centrally), grayish blue with purplish overtones (18E2–18E4), rounded-acuminate at apex, thickening somewhat, occasionally flattening with age to subspathulate, canalliculate, and twisting, smooth, minutely hispid under lens, juncture with stipe distinct, angled. Stipe 9–35 \times 2–4 mm, equal, dark purplish brown (10F8–11F8), appearing smooth but with a minute reticulum under lens, basal mycelium wanting; context somewhat tough, pliant, unchanging. In transverse section context concolorous with stipe, unchanging, solid, hollow centrally; hymenium concolorous, thin (\sim 0.25 mm), with narrow concentric rings. Odor mildly fragrant; taste mild, pleasant, with mealy aftertaste. Macrochemical reactions: FeSO₄, KOH, and NH₄OH nil on all tissues. Spore print white.

Basidiospores 8–9.5 (11) \times (6) 7–8 μ m (mean Q = 1.19), subglobose, smooth, pale golden in H₂O and KOH, inamyloid, with several ill-defined guttules and granules, wall 0.5–1.0 μ m wide; hilar appendix minute, 0.5–0.8 μ m long (Fig. 4). Basidia 62.5–79 (85) μ m long, width at apex 6.3–10 μ m, 2.5–5 μ m at base, subcylindrical to subclavate, pale golden in H₂O and KOH, gloeoporous; post-partial septa observed on most basidia, these 15–30 μ m below apex (Fig. 4); sterigmata 5–10 μ m long, 2.5–3 μ m wide at base, cornute, 2 per basidium. Basidioles numerous. Cystidia none. Uninflated tramal hyphae 2.5–8.8 μ m wide, smooth, hyaline, thin-walled, lacking internal contents. Inflated tramal hyphae up to 22.5 μ m wide, smooth, hyaline, thin walled. Clamp connections frequently observed.

Etymology. Dicymbetorum, Latin, of the *Dicymbe* woods.

Habit, habitat, and distribution. Solitary to scattered on mineral earth beneath root mats in rain forests dominated by *Dicymbe corymbosa*; infrequently encountered throughout the main rainy season (May–July); basidiomata resistant to decay, persisting for several weeks. Known only from the type locality in the Upper Potaro Basin, Guyana.

Specimens examined. GUYANA. Region 8, Potaro-Siparuni: Pakaraima Mountains. Upper Potaro River Basin, vicinity of base camp located near confluence with Whitewater Creek, \sim 20 km east of Mt. Ayanganna: 4 km southwest of base camp, 720 m elevation, under *D. corymbosa*, 3 VII 2004, Henkel 8730 (HOLOTYPE: BRG; ISOTYPE: HSU; GenBank accession: DQ056369 [28S]; DQ056364 [ITS]); 1 km southeast of base camp, 740 m elevation, under *D. corymbosa*, 6 VII 2003, Henkel 8536 (BRG; HSU); 4 km southwest of base camp, 720 m elevation, under *D. corymbosa*, 22 VI 2002, Henkel 8478 (BRG; HSU); 4 km southeast of base camp, 750 m elevation, under *D. corymbosa*, 22 VI 2001, Henkel 8326 (BRG; HSU); 4 km southwest of base camp, 720 m elevation, under *D. corymbosa*, 12 VII 2000, Henkel 7582 (BRG; HSU).

Commentary. *Clavulina dicymbetorum* is recognized in the field by its relatively large, simple basidiomata with bluish-grey hymenium and purplish-brown stipe, and solitary or scattered habit, arising from mineral earth under *D. corymbosa*. *Clavulina dicymbetorum* shares phenotypic features with the Australasian *Clavulina tasmanica* (Berk.) Corner such as the simple basidiomata, similar hymenium color, and similar spore size, but *C. dicymbetorum* differs *inter alia* by its larger basidiomata size and the fact that it lacks the basal mycelial pad and long emergent cystidia found in *C. tasmanica* (PETERSEN 1983). While having similarly large, persistent, simple basidiomata, *Clavulina dicymbetorum* differs *inter alia* from *C.*

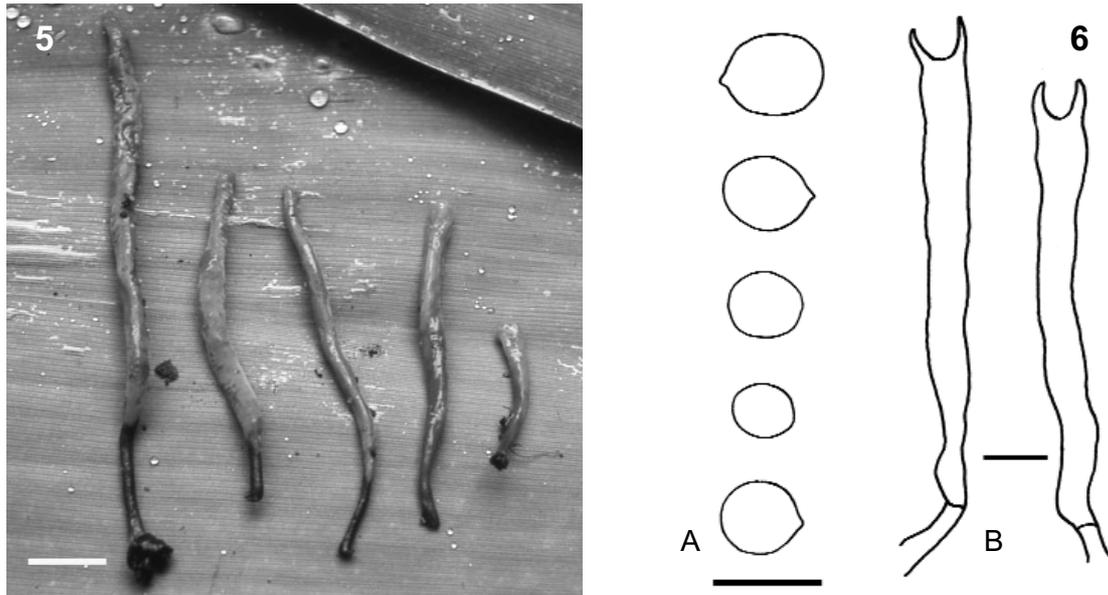


Fig. 5: Basidiomata of *Clavulina humicola* (holotype, *Henkel 8737*). Scale bar = 10 mm. – **Fig. 6:** Microscopic features of *Clavulina humicola* (holotype, *Henkel 8737*). Scale bars = 10 μ m. A. Basidiospores. B. Basidia.

caespitosa described here in its shorter basidia (62–79 μ m vs. 81–98 μ m) with abundant post-partial septa, different basidioma color, as well as its non-caespitose habit and infrequent fruiting. Sequence data from both the 28S and ITS confirm the generic placement of *C. dicymbetorum*, and its genetic distinctiveness from the morphologically similar *C. caespitosa*, described above.

***Clavulina humicola* Henkel, Meszaros et Aime sp. nov.** **Figs. 5–6**

Latin diagnosis: *Clavulinae gracili* Corner simplicibus basidiomatis quasi quam longis similis, sed inter alia armeniis basidiomatis succulentum opacum stipitem habentis, parvioribus (6.5–8.5 \times 6–8 μ m) basidiosporis, longioribus (62.5–81.3 μ m) basidiis differt.

Basidiomata simple, rarely in unfused pairs, 23–70 \times 1.5–3 mm (centrally), cylindrical with rounded-acuminate apex (Fig. 5). Hymenium 14–52 \times 2–2.5 mm (centrally), dull light orangish brown (5C4–5E4), smooth, finely hispid under lens, thickening moderately, occasionally twisting and canaliculate with age, juncture with stipe abrupt, angled. Stipe 4–16 \times 1–1.5 mm, equal, brown (6F6–6F7), smooth, appearing finely pubescent under lens; context fragile. In transverse section context concolorous with base, unchanging, hollow centrally; hymenium thin (~0.25 mm), concentric rings inevident. Odor none; taste slightly mealy. Macrochemical reactions: FeSO₄, KOH, and NH₄OH nil on all tissues. Spore deposit not obtained.

Basidiospores 6.5–8.5 \times 6–8 μ m (mean Q = 1.09), subglobose, smooth, pale golden in H₂O, hyaline in KOH, with several ill-defined guttules and granular contents, inamyloid, wall 1.0–1.5 μ m thick; hilar appendix 0.5–0.8 μ m long (Fig. 6). Basidia 62.5–81.3 μ m long, width at apex 5–7.5 μ m, at base 3.8–5 μ m, subcylindrical, hyaline, gloeoporous; post-

partial septa not observed; sterigmata 6.3–7.5 μ m long, 2.5 μ m wide at base, cornute, 2 per basidium (Fig. 6). Cystidia none. Uninflated tramal hyphae 2.5–10 μ m wide, smooth, thin walled, hyaline, lacking internal contents. Inflated tramal hyphae up to 20 μ m wide, smooth, thin walled, hyaline. Clamp connections not observed.

Etymology. *Humicola*, Latin, referring to its humic fruiting substratum.

Habit, habitat, and distribution. In troops of a few dozen to several hundreds on well-decayed humic deposits on the basal root mounds or in elevated positions on the trunks of large *Dicymbe corymbosa* trees; fruiting most heavily at the beginning of the May–July rainy season. Basidiomata not particularly decay resistant; not persistent. Known only from the type locality in the Upper Potaro Basin, Guyana.

Specimens examined. GUYANA. Region 8, Potaro-Siparuni: Pakaraima Mountains. Upper Potaro River Basin, vicinity of base camp located near confluence with Whitewater Creek, ~20 km east of Mt. Ayanganna: 0.5 km east of base camp, 710 m elevation, on trunk of *D. corymbosa*, 5 VII 2004, *Henkel 8737* (HOLOTYPE: BRG; ISOTYPE: HSU; GenBank accession: DQ056367 [28S]; DQ056368 [ITS]); 3 km south of base camp, 740 m elevation, on root mound of *D. corymbosa*, 6 VI 2001, *Henkel 8245* (BRG; HSU)

Commentary. *Clavulina humicola* is recognized in the field by its simple, small, dull-orange basidiomata occurring in troops on humic accumulations around and on the trunks of large *D. corymbosa* trees. *Clavulina gracilis* Corner from Singapore (CORNER 1950) is the only other *Clavulina* species described with simple basidiomata of similar size, but differs *inter alia* from *C. humicola* in having a white basidioma with a slender, translucent stipe, larger, globose spores (8–10 μ m

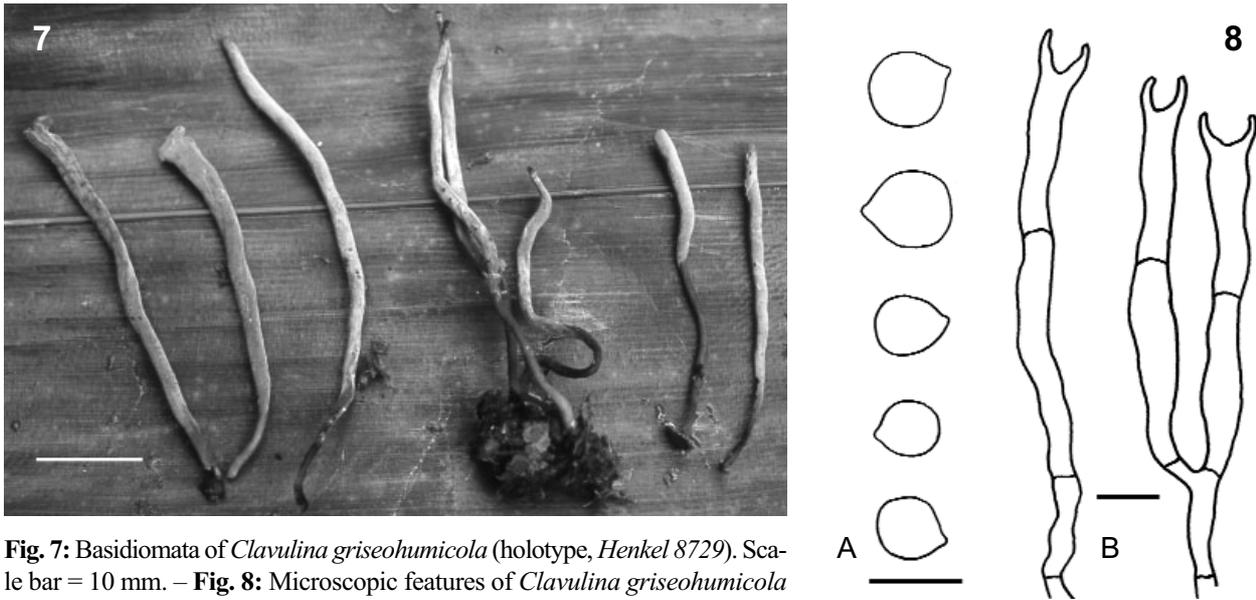


Fig. 7: Basidiomata of *Clavulina griseohumicola* (holotype, Henkel 8729). Scale bar = 10 mm. – **Fig. 8:** Microscopic features of *Clavulina griseohumicola* (holotype, Henkel 8729). Scale bars = 10 μ m. A. Basidiospores. B. Basidia.

diam), and shorter basidia (40–60 μ m). Sequence data from both the 28S and ITS confirm the generic placement of *C. humicola*.

Clavulina griseohumicola Henkel, Meszaros et Aime sp. nov. **Figs. 7–8**

Latin diagnosis: *Clavulinae dicymbetorum* Henkel, Meszaros & Aime simplicibus non-cespitosus basidiomatis, griseo caeruleo hymenio, purpureo-brunneo stipite, pro parte maxime nimis septatis basidiis similis, sed inter alia parvior habitu (< 55 mm), parvioribus basidiis (50–68 μ m), fibulis carentibus, in ampla fascicula humo insidentes proxima arboribus (*Dicymbe corymbosa*) fructifero habitu differt.

Basidiomata simple, occasionally in clusters of two, but not joined at the base, 17–55 \times 1.5–3 mm (centrally), with rounded-acuminate apex (Fig. 7). Hymenium 6–40 \times 1.5–3 mm (centrally), dark bluish gray (12 F3–12F5), smooth, minutely hispid under lens; apex rounded-acuminate, becoming blunt and finely rugulose with age, twisting, and flattening somewhat as hymenium thickens with age. Stipe 6–10 \times 0.5–1.0 mm, equal, burgundy-brown (9E7–9F7), smooth, faintly longitudinally striate under lens, sometimes twisting, basal mycelium wanting; context brittle. In transverse section context dull brown, unchanging, solid; hymenium concolorous, thin (~0.25 mm), with faint concentric zones. Taste and odor none. Macrochemical reactions: FeSO₄, KOH, and NH₄OH nil on all tissues. Spore deposit not obtained.

Basidiospores 8–9.5 \times 7–9 μ m (mean Q = 1.13), subglobose, smooth, pale golden in H₂O, hyaline in KOH, mostly aguttulate, inamyloid, wall 0.5–1 μ m thick; hilar appendix 0.8–1 μ m long (Fig. 8). Basidia 50–68 μ m long, width at apex 5–6.3 μ m, at base 3.8–5 μ m, subcylindrical, gloeoporous; post-partial septa observed on most basidia, these 15–25 μ m below the sterigmata; sterigmata 2.5–6.3 μ m long, 1.3–2.5 μ m wide at base, cornute, 2 per basidium (Fig. 8). Cystidia none.

Uninflated tramal hyphae 2.5–8.8 μ m wide, smooth, thin walled, hyaline, lacking internal contents. Inflated tramal hyphae up to 30 μ m wide, smooth, thin walled, hyaline. Clamp connections not observed.

Etymology. *Griseohumicola*, Latin, referring to the greyish basidioma color and humic fruiting substratum.

Habit, habitat, and distribution. In troops of several dozen, occasionally many more, on well-decayed humic deposits on the basal root mounds or on elevated positions on the trunks of large *Dicymbe corymbosa* trees; fruiting most heavily at the beginning of the May–July rainy season. Basidiomata not particularly decay resistant; not persistent. Known only from the type locality in the Upper Potaro Basin, Guyana.

Specimens examined. GUYANA. Region 8, Potaro-Siparuni: Pakaraima Mountains. Upper Potaro River Basin, vicinity of base camp located near confluence with Whitewater Creek, ~20 km east of Mt. Ayanganna: 1 km southeast of base camp, 740 m elevation, at base of *D. corymbosa*, 2 VII 2004, Henkel 8729 (HOLOTYPE: BRG; ISOTYPE: HSU; GenBank accession: DQ056366 [28S]); 3 km southeast of base camp, 740 m elevation, at base of *D. corymbosa*, 12 VI 2001, Henkel 8259 (BRG; HSU).

Commentary. *Clavulina griseohumicola* is phenotypically similar to *C. dicymbetorum* described here in its simple, non-clustered basidiomata, bluish-grey hymenium and purplish-brown stipe, and abundant post-partial basidial septa. In the field, height of the basidiomata and fruiting habit allows one to separate these species: *C. griseohumicola* does not exceed 55 mm in height, and occurs in medium to large troops on humic deposits near or on *D. corymbosa* trees, while *C. dicymbetorum* often exceeds 100 mm in height, arises from mineral earth beneath the root mat, and fruits as solitary or widely scattered basidiomata throughout the *Dicymbe* stands. Microscopically, *C. griseohumicola* has shorter basidia than *C. di-*



Fig. 9: Basidiomata of *Clavulina monodiminutiva* (holotype, Henkel 8738). Scale bar = 10 mm. – **Fig. 10:** Microscopic features of *Clavulina monodiminutiva* (holotype, Henkel 8738). Scale bars = 10 μ m. A. Basidiospores. B. Basidia.

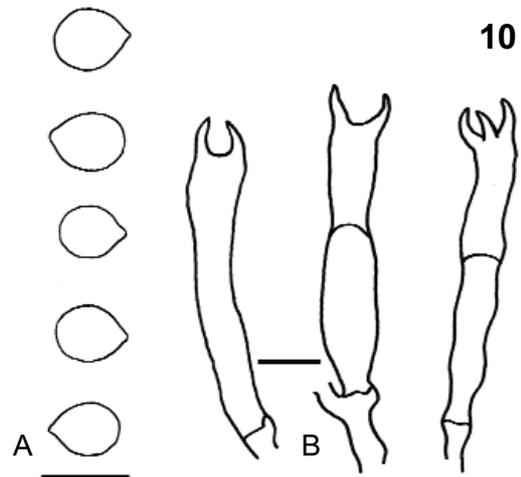
cymbetorum (50–68 μ m vs. 62.5–79 μ m) and lacks clamp connections. Similarities in basidioma size and fruiting habit and lack of clamp connections notwithstanding, *C. griseohumicola* differs *inter alia* from *C. humicola* described here in its longer spores (8–9 μ m vs. 6.5–8.5 μ m), shorter basidia (50–68 μ m vs. 62–81 μ m) and dull orange color. *Clavulina gracilis* Corner from Singapore has simple, solitary basidiomata with similar basidium and spore dimensions, but differs markedly in its white color and possession of clamp connections (CORNER 1950). Sequence data from the 28S confirm the generic placement of *C. griseohumicola*, and its genetic distinctiveness from the phenotypically-similar *C. dicymbetorum*.

Clavulina monodiminutiva Henkel, Meszaros et Aime sp. nov. **Figs. 9-10**

Latin diagnosis: *Clavulinae humili* (Cke.) Corner simplicibus basidiomatis, gregariis parvis lignosis frustris insidentes fructifero habitu similis, sed inter alia parvioribus basidiosporis (6–8 \times 4.5–7 μ m), villosio myceliali pulvino absente ad basim stipitum differt.

Basidiomata simple, unclustered, rarely in unfused pairs, 8–35 \times 1–2 mm (centrally), tip acuminate (Fig. 9). Hymenium 6–31 \times 1–2 mm (centrally), grey to pinkish grey (6C2-6C3-6D3), smooth, finely hispid under lens, thin, barely thickening, apex acuminate. Stipe 2–4 \times 1 mm, tapering slightly towards base, dull orangish tan (5C5), smooth, basal mycelium wanting; context soft, fragile. In transverse section context concolorous, unchanging; hymenium extremely thin. Odor none; taste none. Macrochemical reactions: FeSO₄, KOH, and NH₄OH nil on all tissues. Spore deposit not obtained.

Basidiospores 6–8 (9) \times 4.5–7 μ m (mean Q = 1.32), subellipsoid, smooth, hyaline in H₂O and KOH, often multiguttulate with granular contents, inamyloid; wall 0.3–0.5 μ m thick; hilar appendix 0.8–1.3 μ m long (Fig. 10). Basidia (34)



36–50 μ m long, width at apex 5–8.8 μ m, at base 4–6.3 μ m, subcylindrical, gloeoporous; post-partial septa in most basidia, these 20–30 μ m below sterigmata; sterigmata 3.8–7.5(9) μ m long, 1.3–2.5 μ m wide at base, cornute, most often 2 per basidium but frequently 3, and rarely 4, per basidium (Fig. 10). Cystidia none. Uninflated tramal hyphae 1.3–8.8 μ m wide, smooth, thin walled, hyaline, lacking internal contents. Inflated tramal hyphae up to 29 μ m wide, smooth, hyaline, thin walled. Clamp connections infrequently observed.

Etymology. *Monodiminutiva*, Latin, referring to the monopodial, very small basidiomata.

Habit, habitat, and distribution. In troops of several dozens to hundreds on decaying sticks, wood fragments, and leaves at the base and on trunks of large *Dicymbe corymbosa* trees; soft basidiomata not persistent; fruiting throughout the May–July rainy season. Known only from the type locality in the Upper Potaro River Basin of Guyana.

Specimens examined. GUYANA. Region 8, Potaro-Siparuni: Pakaraima Mountains. Upper Potaro River Basin, vicinity of base camp located near confluence with Whitewater Creek, ~20 km east of Mt. Ayanganna: 0.5 km east of base camp, 710 m elevation, on trunk litter of *D. corymbosa*, 5 VII 2004, *Henkel 8738* (HOLOTYPE: BRG; ISOTYPE: HSU; GenBank accession: DQ056372 [28S]; DQ056365 [ITS]); 3 km southwest of base camp, 720 m elevation, at base of *D. corymbosa*, 6 VI 2001, *Henkel 8246* (BRG; HSU).

Commentary. *Clavulina monodiminutiva* is distinctive among sympatric *Clavulina* spp. in Guyana in its very small, gray, simple basidiomata occurring in large troops on leaves, sticks, and wood fragments on the ground or on the trunks of *D. corymbosa* trees. Among *Clavulina* spp. described by CORNER (1950) with simple basidiomata and gregarious fruiting on organic materials, *Clavulina floridana* (Singer) Corner, from Florida, USA, differs *inter alia* from *C. monodiminutiva* in its much taller basidiomata (50–65 mm), larger, more globose spores, lack of clamp connections, and presence of numerous secondary septa in the tramal hyphae. *Clavulina humilis* (Cke.) Corner, from New Zealand, has extremely small basidiomata (< 15 mm tall), and fruits gregariously on rotten wood and sticks, but differs from *C. monodiminutiva* in its longer spores (8–10 µm vs. 6–8 µm) and presence of a villous mycelial pad at the stipe base. *Clavulina pampeana* (Speg.) Corner has small, simple, gregarious basidiomata, but has longer spores (7–11 µm) than *C. monodiminutiva* and occurs in grasslands of the Argentinian pampas. Sequence data from both the 28S and ITS confirm the generic placement of *C. monodiminutiva*.

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