

Five new species and records of *Inocybe* (Agaricales) from temperate and tropical Australia

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Abstract

Bougher, N.L., Matheny, P.B. & Gates, G.M. Five new species and records of *Inocybe* (Agaricales) from temperate and tropical Australia. *Nuytsia* 22(2): 57–74 (2012). Five species of *Inocybe* (Fr.) Fr. are documented from Australia, four from southern temperate regions and one from the northern tropics. *Inocybe emergens* (Cleland) Grgur., previously known only from the type collection in South Australia, is reported for the first time from south-west Western Australia. *Inocybe fulvilubrica* Matheny, Bougher & G.Gates and *I. redolens* Matheny, Bougher & G.Gates are both described from Western Australia and Tasmania. *Inocybe fulvilubrica* has nodulose spores, a yellowish brown pileus that may be viscid or greasy and bears patches of white velar material, and a white pruinose stipe with a marginate bulb. *Inocybe redolens* is distinguished by the combination of nodulose spores, a squamulose disc, lack of caulocystidia, and an odour of *Pelargonium*. *Inocybe sinuospora* Matheny & Bougher known only from southwest Western Australia, has distinctive oblong-angular spores with a sinuous outline. *Inocybe torresiae* Matheny, Bougher & M.D.Barrett is a tropical species with nodulose spores described from forests in northern Western Australia and Queensland. It is distinguished by its truncate or sessile hymenial cystidia, presence of caulocystidia, and sweet or citrine odour.

Introduction

The ectomycorrhizal genus *Inocybe* (Fr.) Fr. (Inocybaceae, Agaricales) occurs throughout most climatic and vegetation regions of Australia. This is indicated by the overall data accompanying several hundred voucher collections of *Inocybe* held in Australian herbaria. However, the scope of diversity for the genus in Australia is unknown because the identity of most of these herbarium collections remains undetermined, and many regions of Australia are poorly sampled. Currently, only 14 species of Australian *Inocybe* are accepted. A recent evaluation of Australian type collections classified in *Inocybe* accepted 12 species of *Inocybe* together with five species of the closely related genus *Auritella* (Matheny & Bougher 2010). More recently, two additional species of *Inocybe* have been documented: *Inocybe curvipes* P. Karst. and *I. rufuloides* Bon., both associated with exotic plants

introduced into Australia (Bougher & Matheny 2011). However, there is a much greater diversity of *Inocybe* in Australia. This contention is supported by recent preliminary morphological examinations and molecular phylogenetic analyses (Matheny *et al.* 2009; current authors' unpublished data).

All Australian species of *Inocybe* accepted so far are recorded from southern temperate Australia where the majority of Australia's larger fungi in general have been described. This paper contributes to monographic studies of the family Inocybaceae in Australia by reporting four species of *Inocybe* from southern temperate regions and one species from northern tropical regions of Australia.

Methods

Fresh fruit bodies collected from the field were described following colour notations of Munsell Soil Color Charts (1954), Ridgway (1912), or Kornerup and Wanscher (1967) and then air-dried for later examination. The number of lamellae that reach the stipe is indicated by 'L'. Hand sections for microscopic observations were mounted in 3% KOH and in 1% Congo Red. Microscopic characters were drawn with a Nikon drawing tube system. Application of the terms velipellis, caulocystidia, paracystidia, cauloparacystidia, and caulocystidioid cells follows Kuyper (1986). Spore measurements include the hilar appendix and nodules. Outlier measurements, i.e., those that fall within 5% of the smallest and largest measurements, are indicated in parentheses. The number of nodules per spore was estimated by counting nodules through all possible planes of view (Matheny & Kropp 2001).

DNA sequences of the internal transcribed spacer regions (ITS), the 5' end of the nuclear large subunit ribosomal RNA region (nLSU), and the most variable region of *rpb2*, which encodes the second largest subunit of RNA polymerase II, were produced following protocols outlined in Judge *et al.* (2009) and Matheny (2005). Sixteen new sequences (accession numbers JQ085922–JQ085937) have been deposited at GenBank. The new sequences were used as queries of the NCBI nucleotide sequence database using the BLASTn search algorithm.

Taxonomic description

Inocybe emergens (Cleland) Grgur., *Larger Fungi of South Australia*: 192 (1997). *Astrosporina emergens* Cleland, *Trans. Roy. Soc. S. Australia*. 57: 192 (1933). *Type*: Kinchina, South Australia, 8 June 1925, *J.B. Cleland s.n. (holo: AD 40426)*.

Pileus 10–30 mm diam., plano-convex to plane or applanate; umbo absent; margin inrolled when young, becoming decurved, arching slightly upwards with age; surface dry but at times with much adhering soil, finely fibrillose to felty, especially the inrolled margin when young, at times with whitish scattered mouldy patches of velipellis material that may be heavy particularly when young, foxy brown (6D7–6E7) or near 'Amber Brown', 'Hazel', or 'Cinnamon–Brown' to pale brown (5B4) or various shades thereof, lighter or almost whitish where densely covered with veil material, the inrolled margin when young almost white; context pallid, not changing colour where bruised. *Lamellae* adnexed, close with numerous tiers of lamellulae, white when young becoming gray-brown (5C4) to pale brown (near 6D6); edges pallid or concolorous, fimbriate or at times indistinctly so, up to 5 mm deep. *Stipe* 21–25 × 5–6 mm, even, terete, the base swollen or with a weak marginate bulb that may be covered with soil or sand, relatively robust in relation to the pileus, upper part noticeably pruinose, overall with a silky-fibrillose appearance, glabrescent, in age not so evidently pruinose, white to pale yellow but dulling with age; cortina not observed; context solid, white. *Odour* none. *Taste* not recorded.

Basidiospores 8.0–11.0(–13.0) × 5.5–7.0(–7.5) μm , mean 9.9 × 6.3 μm , Q: 1.33–1.75(–1.96), Q mean 1.57 (n=42/4), oblong–angular, at times angular–subphaseoliform to subtrapeziform, often with a ventral concave depression, usually with 8–11 low, obtusely conical nodules or merely weak corners, often with a distinct apical nodule, yellowish brown in KOH. *Basidia* 32–40 × 9–10 μm , clavate, 4-sterigmate, occasionally 2-sterigmate, hyaline. *Pleurocystidia* 40–75 × 11–21 μm , utriform to fusiform, at times subclavate, subcylindric, or broadly fusiform less often saccate, the apices well-rounded to obtuse and crystalliferous, with a basal pedicel, mostly thick-walled, the walls 1.5–4.0 μm thick, but on occasion only up to 1.5 μm thick apically, hyaline to pale yellow in KOH, frequent but not so in some collections (as in E5551 and the type). *Cheilocystidia* 27–75 × 8–20 μm , similar to pleurocystidia, at times with swollen or indistinctly subcapitate apices, thick- or thin-walled, sometimes partly or entirely with brown cytoplasm, mixed with clavate, thin-walled, hyaline paracystidia. *Stipitipellis* composed of caulocystidia mixed with clusters of cauloparacystidia descending the entire length of the stipe; caulocystidia similar to cheilocystidia, at times with swollen or subcapitate apices (typically lacking crystals), occasionally irregular in shape, thick-walled, rarely thin-walled (as in E6631). *Pileipellis* with a superficial interwoven layer of hyaline, smooth, narrowly cylindrical, 3–8 μm wide velipellis hyphae; subcutis of repent hyphae, ochraceous brown or ‘Ochraceous–Tawny’ pigmented in mass, the hyphae cylindrical, to 15 μm wide, encrusted. *Clamp connections* present in all tissues. (Figures 1, 2)

Other specimens examined. [arranged chronologically] WESTERNAUSTRALIA: 39.7 km S of Dongara, on sandy soil, 15 June 1989, B. Dell E645, OKM23943 (PERTH 07548257); Higginson Rd, site 17, 20 km N of Kellerberrin, on ungrazed ground under *Gastrolobium* and *Eucalyptus salmonophloia*, 15 June 1995, N.L. Bougher E5458 (PERTH 07709943); Higginson Rd, site 17, 20 km N of Kellerberrin, on ground under *Allocasuarina* and *Acacia*, 15 June 1995, W. Dunstan & I. Tommerup E5462 (PERTH 07710062); Higginson Rd, Hilltop site 17B, 16 km along Bencubbin–Kellerberrin Rd, N of Kellerberrin,

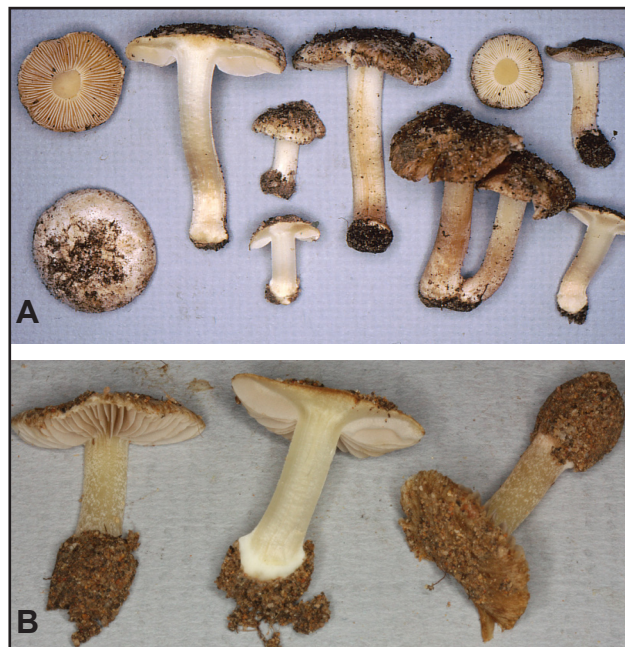


Figure 1. Basidiomes of *Inocybe emergens*. A – PERTH 07709943; B – PERTH 08320462.

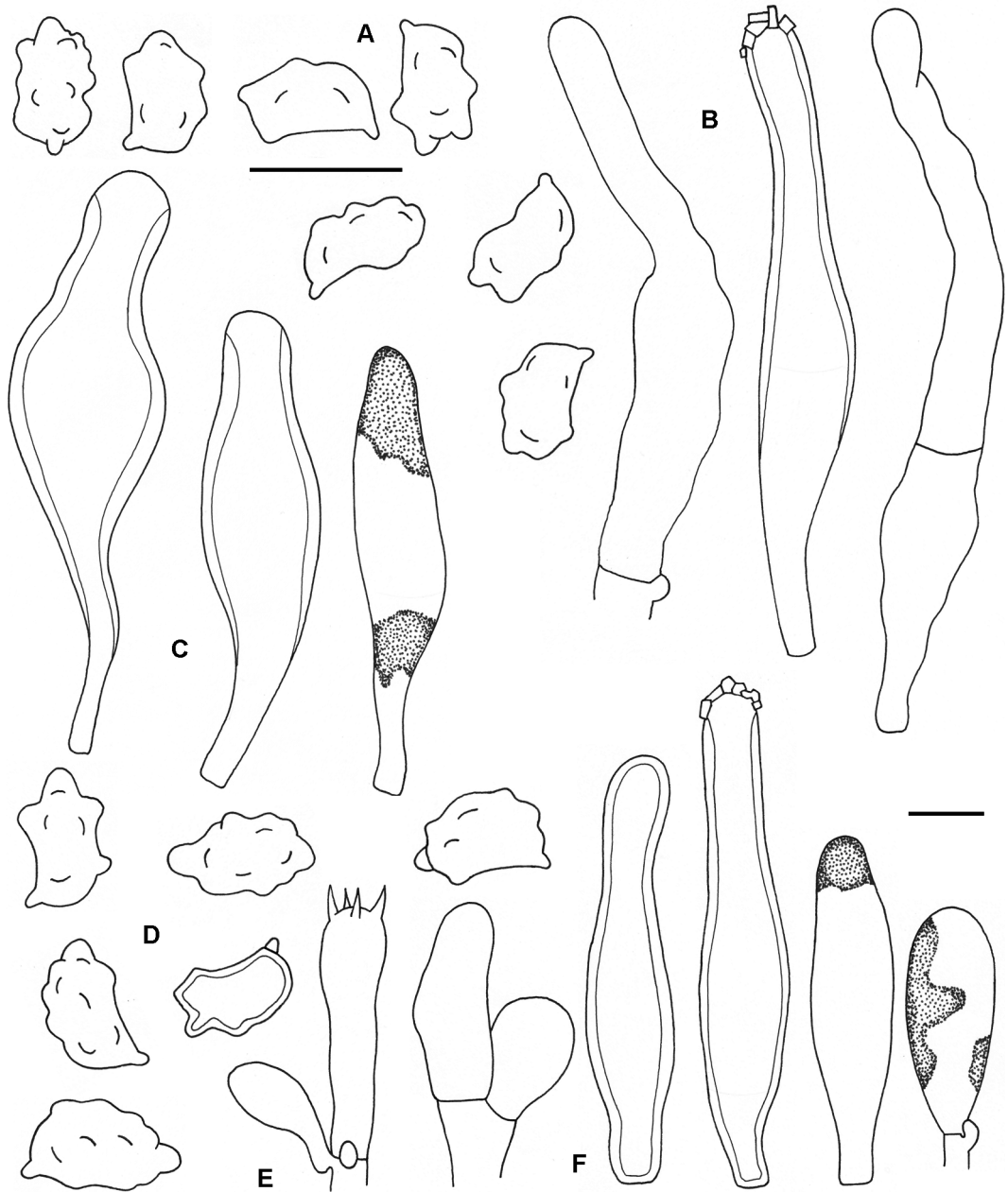


Figure 2. Micromorphology of *Inocybe emergens*. (All PERTH 07659903 except A). A – spores (PERTH 08320365); B – caulocystidium and caulocystidioid hairs from near the stipe apex; C – pleurocystidia; D – spores; E – basidium; F – cheilocystidia. Scale bars = 10 μ m (longer bar for spores only).

under *Allocasuarina campestris* and *Acacia* sp., 5 July 1995, *I. Tommerup* E5531 (PERTH 07605323); Higginson Rd, Hilltop site 17A & B, 16 km along Bencubbin–Kellerberrin Rd, N of Kellerberrin, under *Eucalyptus wandoo* and *Allocasuarina campestris*, 19 July 1995, *W. Dunstan* E5551 (PERTH 07608144); site 18, 31 km along Bencubbin–Kellerberrin Rd, north of Kellerberrin, under *Eucalyptus salmonophloia*, 20 July 1995, *I. Tommerup* E5555 (PERTH 07608136); Vinegar Well, off Barber Rd, Kunjin, 20 km W of Corrigin, in litter on ground under *Eucalyptus loxophleba* and *Acacia acuminata* in an open woodland, 1 July 1999, *J. Catchpole*, *I. Tommerup* & *N.L. Bougher* E6203 (PERTH 07659903) (JQ085935-ITS, EU569837-*rpb1*, EU569838-nLSU); Valema Farm, Paddock 51, Grylls Rd, Corrigin Shire, on ground with moss under *Melaleuca spicigera*, *M. uncinata* and *Leptospermum erubescens*, 12 July 1999, *J. Catchpole*, *I. Tommerup*, *S. Bolsenbroek* & *N.L. Bougher* E6250 (PERTH 07658664); Vinegar Well, off Barber Rd, Kunjin, 20 km W of Corrigin, scattered on ground under *Acacia acuminata*, 19 July 2000, *N.L. Bougher* & *I. Tommerup* E6631 (PERTH 07674325); Dryandra State Forest, fungi survey site 5, under *Corymbia calophylla* in a low woodland over low heath including *Gastrolobium microcarpa* and *Hypocalymma angustifolium*, 30 May 1992, *Australian Plant Pathology Society* DRYANDRA7 (PERTH 2342626); Two Peoples Bay Nature Reserve, Rocky Point Track, under *Melaleuca thymoides*, *Agonis flexuosa*, *Spyridium globulosum* and *Westringia*, 28 May 1992, *K. Syme* KS 539/92A (PERTH 05429684) (note this material is heterogeneous); Vinegar Well, off Barber Rd, Kunjin, 20 km W of Corrigin, occurring in sand as single fruit bodies, often buried, under *Allocasuarina* sp., 27 July 2011, *P.B. Matheny* PBM 3687 (PERTH 08318980, TENN066554); old dismantled Kunjin railway, about 14 km west of Corrigin, solitary near planted eucalypts and *Allocasuarina* bushes, 26 July 2011, *N.L. Bougher* 00878 (PERTH 08320527); Corrigin wildflower drive, 5 km west of Corrigin, scattered singly in *Allocasuarina campestris* thicket, 27 July 2011, *N.L. Bougher* 00884 (PERTH 08320462); Vinegar Well, off Barber Rd, Kunjin, 20 km west of Corrigin, scattered singly in open woodland of *Eucalyptus kondininensis* and *Acacia acuminata*, 27 July 2011, *N.L. Bougher* 00893 (PERTH 08320365); Vinegar Well, off Barber Rd, Kunjin, 20 km W of Corrigin, scattered singly near *Acacia acuminata* and *Allocasuarina huegeliana*, 27 July 2011, *N.L. Bougher* 00896 (PERTH 08320349).

Distribution and habitat. In various habitats supporting diverse vegetation containing *Allocasuarina* (Casuarinaceae), *Acacia* and *Gastrolobium* (Fabaceae), species of *Eucalyptus*, *Corymbia*, *Melaleuca*, *Leptospermum*, *Hypocalymma* and *Agonis* (Myrtaceae), and *Spyridium* (Rhamnaceae). Common in the wheatbelt region of south-west Australia and recorded along the southern coast east of Albany. The type is from South Australia, but *I. emergens* has not been reported in southeastern Australia. Fruiting June and July in the Western Australian wheatbelt, May along the southern coast, June in South Australia.

Notes. *Inocybe emergens* is recognised microscopically by the predominantly angular spore outline with 7–11 indistinct nodules and a ventral concave depression. In some collections a low proportion of spores have more prominent obtuse nodules. Caulocystidia can be found the entire length of the stipe and characteristically include some with swollen or subcapitate apices. This latter feature is also found in *I. sinuospora* Matheny & Bougher (described below), which is closely related and sometimes occurs at the same location as *I. emergens*.

In the field, the pileus colour of *I. emergens* varies from orange-brown to pale brown, at times with conspicuous patches of an appressed, thin, white velipellis. The degree of the development of the velipellis influences the overall pileus colour. The stipe is conspicuously pruinose (at least in younger specimens) along its entire length, and is generally robust with a swollen or indistinctly marginate basal bulb. Many collections of *I. emergens* feature squat fruit bodies where the stipe length rarely exceeds the pileus diameter.

Western Australian material corresponds well microscopically with the type of *I. emergens*, originally described by Cleland from South Australia (Matheny & Bougher 2010). Spore dimensions of most western collections tend to be somewhat larger than the type but do overlap in size. Cleland (1933) originally described the pileus as ‘pallido-luteus’, which could be construed from material with a prominent velipellis, but we did not observe superficial velipellar hyphae in our examination of the type. All other gross morphological features described by Cleland are consistent with collections documented here.

Attention should be drawn to PERTH 07709943, collected under *Gastrolobium* and *Eucalyptus* in Western Australia. Many specimens of this collection have a very well developed velipellis, but differ from others by many spores with more numerous (10–14) nodules with occasional spores similar to *I. emergens*. At present, we are unsure whether this collection represents a distinct taxon. Note also should be made of PERTH 05429684, which contains a heterogeneous mixture of a smooth-spored species and specimens of *I. emergens*. At least one undescribed smooth-spored species resembles *I. emergens* in the field, so care should be made when assembling a collection. A thorough molecular genetic analysis of collections that correspond to *I. emergens* has not yet been performed. However, we recognize the species based primarily on morphological criteria at present.

Inocybe fulvilubrica Matheny, Bougher & G.Gates, *sp. nov.*

Typus: Kermandie Falls, Lower Track, Tasmania, gregarious to scattered singly on soil along track in wet sclerophyll forest under *Eucalyptus*, *Acacia dealbata*, *Pomaderris apetala*, 9 May 2010, G. Gates & P.B. Matheny PBM3352 (*holo*: TENN 065756; *iso*: PERTH 08309051); JQ085922-nLSU.

Mycobank. MB 564189.

Pileus 15–40 mm diam., parabolic or conical when young, expanding to plano-convex, at times campanulate, when expanded often with an obtuse umbo; margin incurved when young, later decurved or uplifted and undulating in age; surface soapy-lubricous when wet otherwise with a dry texture; velipellis present as scattered white mouldy patches or absent in age or absent altogether; disc smooth and unbroken, radially appressed-fibrillose or at most weakly rimulose towards the margin, at times torn, generally with an aspect and colour like *I. mixtilis* or *I. praetervisa* (two temperate Northern Hemisphere species), yellowish brown (10YR 5/6–5/4) or brownish yellow (10YR 6/6–5/6), in age with shades of brown (10YR 5/3), at times light olive-brown or isabelline (2.5Y 5/6) towards the margin, overall fulvous or ‘Clay Color’ to ‘Buckthorn Brown’; context pallid, not changing colour where bruised. *Lamellae* adnexed or sinuate to subfree, moderately close to close, about 30–40 L, with several tiers of lamellulae, pale yellow (5Y 7/4), pale olive (5Y 6/4), or very pale brown (10YR 7/3) to pale brown and eventually brown (10YR 6/3–5/3) or with olivaceous tints (5Y 5/6) in age, narrow to medium, up to 4 mm broad; edges pallid and indistinctly fimbriate. *Stipe* 20–45 × 3–7 mm at the apex, terete or compressed, even down to the marginately bulbous base which is 5–9 mm wide, white but with a pale buff or yellow undertone in age; surface densely pruinose and densely so (Tasmanian collections) or less dense (Western Australian collections) along the entire length with a silky-satiny appearance; context solid, white or pallid. *Odour* not remarkable (Tasmanian collections) or weakly spermiatic (Western Australian collections). *Taste* none.

Basidiospores (7–)7.5–10 × (5–) 5.5–7.0(–7.5) μm, mean 8.3 × 5.8 μm, Q: 1.24–1.72, Q mean 1.46 (n=30/1), coarsely gibbous, not stellate, with numerous (12–15) conical distinct nodules, at times with a single wedge-shaped nodule up to 3.5 μm high, yellowish brown in KOH. *Basidia* 22–31 × 7–10 μm,

clavate, 4-sterigmate, hyaline. *Pleurocystidia* 54–72 × 14–20 µm, mostly slenderly fusiform but at times lageniform, very thick-walled, the walls 4.0–6.0 µm thick, pale yellow; apices obtuse, crystalliferous. *Cheilocystidia* 40–60 × 13–18 µm, cylindric to fusiform or slenderly lageniform with obtuse apex up to 12 µm wide; walls up to 5 µm thick including at apex. *Stipitipellis* with caulocystidia along the entire length of the stipe but sometimes less abundant below apex of stipe, similar to pleurocystidia but often lageniform, scattered in association with dense clusters of broadly clavate or pyriform, thin-walled and hyaline cauloparacystidia. *Pileipellis* a superficial epicutis of mostly repent, cylindric and smooth hyphae 3–8 µm diam. with a subpellis consisting of a yellowish brown pigmented layer of cylindric and encrusted hyphae up to 18 µm diam. *Clamp connections* present in all tissues. (Figures 3, 4)

Other specimens examined. [arranged chronologically] TASMANIA: Mt Field National Park, on soil in wet sclerophyll forest under *Eucalyptus regnans*, *Acacia*, *Pomaderris*, 8 June 2009, G. Gates, D. Ratkowsky, & P.B. Matheny PBM3218 (TENN 065760) (JQ085923-nLSU); Cuckoo Falls, near Scottsdale, on soil in wet sclerophyll under *Acacia*, *Pomaderris*, *Eucalyptus*, 24 May 2010, P.B. Matheny PBM3407 (TENN 065755) (JQ085924-ITS, JQ085925-nLSU); Mt Field National Park, track to Lady Barron Falls, scattered singly on soil in dry sclerophyll under *Eucalyptus obliqua*, *Acacia*, 1 June 2010, G. Gates & P.B. Matheny PBM3435 (TENN 065758) (JQ085926-ITS, JQ085927-nLSU); same locality as previous, 1 June 2010, G. Gates & P.B. Matheny PBM3436 (TENN 065757); Mt Field National Park, on track to Lady Barron Falls, scattered singly in wet sclerophyll under *Nothofagus*, *Acacia*, *Pomaderris*, *Eucalyptus regnans*, 1 June 2010, G. Gates & P.B. Matheny PBM3440 (TENN 065759) (JQ085928-ITS, JQ085929-nLSU, JQ085930-rpb2); Myrtle Gully, 9 Nov. 2000, G. Gates & D. Ratkowsky Gates I 3a (TENN 065761, HO 563719) (JQ085931-nLSU). WESTERN AUSTRALIA: Walpole–Nornalup National Park, scattered to gregarious, solitary or in



Figure 3. Basidiomes of *Inocybe fulvilubrica*. A – HO 563719; B & C – PERTH 08320640.

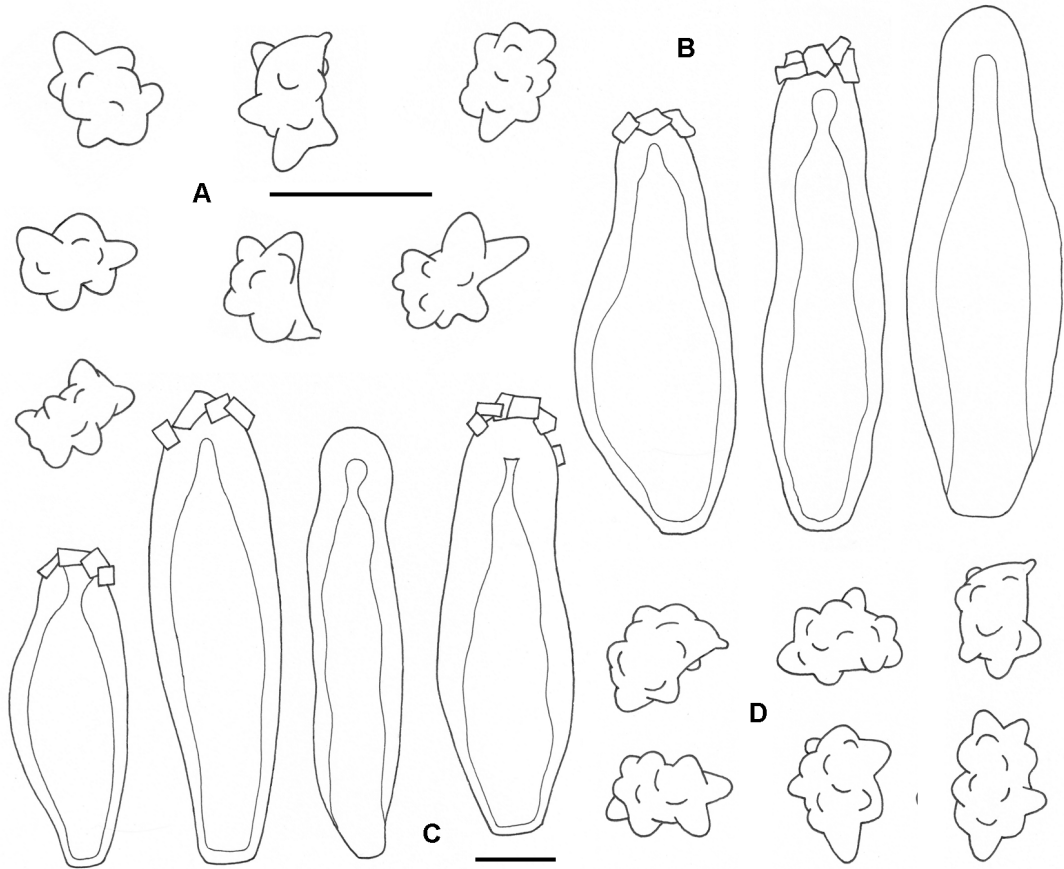


Figure 4. Micromorphology of *Inocybe fulvilubrica* (All PERTH 07651708 except A). A – spores (TENN 065756); B – pleurocystidia; C – cheilocystidia; D – spores. Scale bars = 10 μm (longer bar for spores only).

pairs, on sandy soil under *Eucalyptus patens* near track in disturbed Karri–Marri forest, 25 June 2001, *N.L. Bougher* E6776, PBM2134 (PERTH 07651708) (JQ085932-ITS, EU569849-*rpb2*, EU569848-*rpb1*, EU569850-nLSU); Jarrahdale Rd, 8 km west of Albany Highway, solitary amid litter under *Eucalyptus marginata* and *Corymbia calophylla* in Jarrah–Marri forest, 25 July 2011, *N.L. Bougher* 00867 (PERTH 08320640).

Distribution and habitat. On soil in wet and dry sclerophyll forest in Tasmania and south-west Western Australia in association with *Eucalyptus*, *Corymbia*, *Acacia* and/or *Pomaderris*. Fruiting May–July.

Etymology. From the Latin *fulvus* (tawny, yellowish brown) referring to the colour of the pileus, and *lubricus* (smooth, slippery) referring to the soapy-lubricous pileus surface when wet.

Notes. *Inocybe fulvilubrica* is distinguished by its yellowish brown pileus which is soapy-lubricous when wet or bearing patches of a white velipellis, white pruinose stipe with a marginate bulb, and coarsely nodulose spores often including a single wedge-shaped nodule. The above is a composite description from multiple collections confirmed as conspecific by DNA sequence analysis. Initially, two taxa were

thought to be involved: one with a distinct lubricous pileus without a velipellis, and a second taxon with a drier pileus and presence of conspicuous white mouldy patches of veil material. However, DNA sequences of these collections are virtually identical, with minor divergence in Western Australian material (lubricous, smooth pileus). Collection TENN 065759 from Tasmania differs slightly (3–4 bp at nLSU and *rpb2* loci, respectively) from one of the two Western Australian collections (PERTH 07651708). However, microscopic examination of the pileipellis of the latter collection reveals presence of superficial velipellis hyphae. Among Tasmanian collections, presence/absence of the velar remnants on the pileus is highly variable, as also appears to be the case in *I. emergens* (see above).

The ITS region is heterogeneous in several of the Tasmanian collections sampled to date, which precludes direct sequencing of this gene region from these materials. We were able to produce a partial ITS sequence (including the 5.8S and ITS2 region) for PERTH 07651708 and the entire ITS region for TENN 065755 and TENN 065759.

Inocybe fulvilubrica closely resembles a second brown to yellowish brown-capped species observed in Tasmania and south-west Western Australia (e.g. PBM 3217). However, this species is nested within the north temperate *I. praetervisa* complex and is yet to be described. This latter species appears to be distinguished by its somewhat more robust size (pileus 35–45 mm across; stipe 55–60 mm × 5–10 mm wide) and a dense accumulation of white fibrils just above the stipe base. *Inocybe fulvilubrica* is allied with at least seven other nodulose-spored species of *Inocybe* from eastern Australia and New Zealand, all of which are characterized by an entirely or almost entirely pruinose stipe, including *I. amygdalina* (E. Horak) Garrido, which we have confirmed from Australia (current authors' unpublished data). Data from Matheny *et al.* (2009) indicate *I. fulvilubrica* might be part of a larger consortium of species including temperate and neotropical taxa with entirely pruinose stipes and nodulose spores.

Inocybe redolens* Matheny, Bougher & G. Gates, *sp. nov.

Typus: Lake Beedelup, 22 km west of Pemberton, walk-through tree trail near Karri Valley Resort, Western Australia, one clustered pair in soil in forest dominated by *Eucalyptus diversicolor*, 18 August 2001, P.B. Matheny E7034, PBM2185 (*holo*: PERTH 07676654); JQ085933-ITS, EU600843-*rpb1*, EU600844-nLSU.

Mycobank. MB 564190.

Pileus 7–12 mm diam., conical to obtusely so; margin decurved; umbo absent; surface dry with small appressed fibrillose squamules around the centre and towards the margin, the edge of the margin fibrillose; colour dark brown (10YR 3/3), or 'Bister' to 'Mummy Brown' at the centre, shading to (dark) yellowish brown or umbrinous, 'Snuff Brown' or 'Prout's Brown' towards the margin; context pallid, thin, about 1 mm thick. *Lamellae* narrowly adnate to adnexed, ventricose, moderately close, about 30 L with several tiers of lamellulae, light grey to pale brown, the edges pallid, fimbriate. *Stipe* 15–20 × 1.5–3.0 mm at apex, terete, even, with a slightly swollen base, up to 3.0 mm wide, the entire surface overlain with a pallid, silky-fibrillose superficial layer; apex faintly pruinose; base densely covered with pallid fibrils; ground colour light brown to pink or reddish yellow (7.5 YR 6/4–7/4–7/6) 'Avellaneous' to 'Light Pinkish Cinnamon'; context with light dull pinkish tinge to the cortex, the interior pallid, solid; cortina fugacious. *Odour* of *Pelargonium*. *Taste* not recorded.

Basidiospores (7.0–)7.5–9.0 × 5.5–7.5(–8.5) μm, mean 8.0 × 5.8 μm, Q: 1.12–1.65, Q mean 1.39 (n = 30/1), nodulose with mostly 12–14 moderately-sized hemispheric or obtusely conical nodules around



Figure 5. Basidiomes of *Inocybe redolens* (PERTH 07676654).

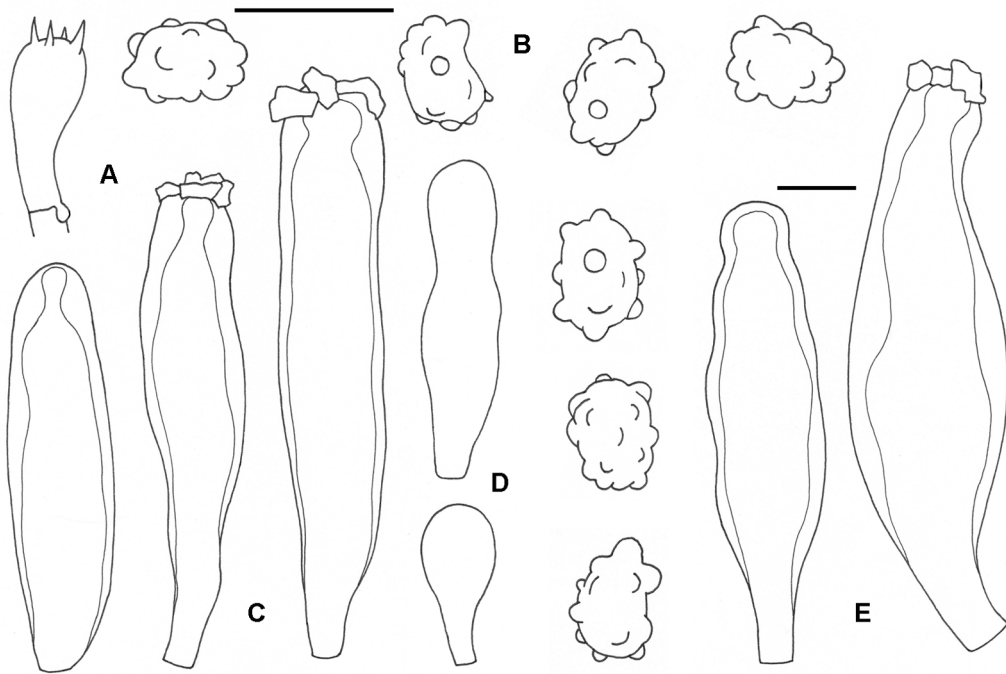


Figure 6. Micromorphology of *Inocybe redolens* (PERTH 07676654). A – basidium; B – spores; C – cheilocystidia; D – paracystidia; E – pleurocystidia. Scale bars = 10 μm (longer bar for spores only).

an elliptic outline, yellowish-brown in KOH. *Basidia* 30–32 × 8–10 μm, clavate, 4-sterigmate, hyaline. *Pleurocystidia* 63–73 × 14–15 μm, more or less cylindrical to narrowly utriform; pedicel long and slender; apices at times swollen or indistinctly subcapitate, crystalliferous; walls 1.5–2.5 μm thick. *Cheilocystidia* 55–70 × 12–14 μm, similar to pleurocystidia, at times intermediate in size and shape, crowded and mixed with abundant paracystidia. *Stipitipellis* lacking caulocystidia but caulocystidioid cells present and restricted to the apex, these similar to cheilocystidia but cauloparacystidia not observed; vesture hyphae present below, these thin-walled and denser towards the lower part of the stipe. *Pileipellis* a cutis of brown (in KOH) hyphae 6–9 μm wide; hyphae mainly thin-walled but some with walls up to 1 μm thick and minutely encrusted. *Clamp connections* present in all tissues. (Figures 5, 6)

Distribution and habitat. On soil in Karri forest under *Eucalyptus diversicolor* and *Corymbia calophylla* in southwest Western Australia, and in mixed forest of *Eucalyptus*, *Melaleuca*, *Nothofagus*, and *Phyllocladus* in Tasmania. Fruiting August to November.

Other specimen examined. TASMANIA: Mount Mangana, Bruny Island, on soil in mixed forest of *Eucalyptus*, *Melaleuca*, *Nothofagus*, and *Phyllocladus*, 15 Nov. 2001, G. Gates & D. Ratkowsky I 18 (HO 563720) (JQ085934-nLSU).

Etymology. The specific epithet is from the Latin *redolens* meaning fragrant.

Notes. *Inocybe redolens* is distinguished by its *Pelargonium*-like odour, which is noticeable without needing to crush the flesh. The ellipsoid and gibbous spores and the dark brown to brown squamulose disc are other distinctive features. Some other species of *Inocybe*, particularly from Europe, have been described with a *Pelargonium*-like odour. Kuyper (1986) refers to 11 species that may exhibit the odour out of 93 in his European monograph. This Australian species, together with *I. cerasphora* Singer from temperate South America, is phylogenetically related to the *I. lanuginosa* (Bull.) P. Kumm. group (Matheny *et al.* 2009). Only two collections of *I. redolens* are known to date. Therefore it is not known if this species is widely distributed throughout temperate Australia. Seven base-pair positions, three of which are polymorphic, differ at the nLSU locus between Tasmanian and Western Australian collections of *I. redolens*. We do not consider this difference to warrant separation of the collections at the species level at this time due to lack of sufficient taxon sampling.

Inocybe sinuospora* Matheny & Bougher, *sp. nov.

Typus: Higginson Road, Hilltop site (17A/B), 16 km north of Kellerberrin along Bencubbin–Kellerberrin Road, Western Australia, scattered on ground under *Allocasuarina*, 29 June 1998, *I. Tommerup* E5980 (*holo:* PERTH 07606532); JQ085936-ITS, EU600860-*rpb1*, EU600861-nLSU.

Mycobank. MB 564191.

Pileus 10–30 mm diam., broadly convex to plano-convex even when relatively young, soon plane; margin decurved to straight; disc at times with a small obtuse umbo; surface dry but at times with adhering grains of sand, a velipellis occasionally present over the disc, the surface fibrillose but not coarsely so; colour fulvous or brownish yellow to dull yellow-brown or ‘Buckthorn Brown’ to cinnamon-brown (near 6D6–6D5) or a mixture of these shades, in age dark yellowish brown or ‘Dresden Brown’; context pallid with a yellowish tinge, not changing colour upon exposure, up to 4 mm thick. *Lamellae* adnexed to adnate, ascending adnate, or uncinata, moderately close to close (44–54 L) with several tiers of lamellulae, ventricose, up to 5 mm broad, very pale yellowish brown

to dark yellowish brown (6E7 or 10YR 4/4); edges pallid and indistinctly fimbriate. *Stipe* 11–30 × 3–10 mm, terete, even, with a small non-marginate basal bulb or appearing even throughout; upper surface pruinose, fibrillose to slightly furfuraceous below, glabrescent in age, pale honey or buff; context solid becoming hollow, pallid to pale brownish or at times with dull yellow tinge, white near the base. *Odour* none. *Taste* not recorded.

Basidiospores (9.5–)10.0–12.5(–13.0) × 4.5–6.0 μm, mean 10 × 5.3 μm, Q: (1.82–)1.90–2.33(–2.56), Q mean 2.10 (n=30/1), oblong-angular, subtrapeziform, oblong-amygdaliform, often with a few shallow sinuses, sometimes with a ventral depression; apices variable, attenuated and narrower than base, or bluntly pointed to rounded and broader than base, gently undulating, rarely with 1–2 indistinct low nodules or corners, rarely entirely smooth; colour yellowish brown in KOH; apiculus small but prominent; walls thin or occasionally thick. *Basidia* 29–37 × 8–12 μm, clavate, 4-sterigmate, hyaline or collapsed and filled with yellow, granular content. *Pleurocystidia* relatively frequent, 51–70 × 14–18 μm, utriform to subfusiform with short necks, with a short or slender basal pedicel; apices obtuse, crystalliferous or bare; walls thick apically, up to 3.0 μm thick, hyaline. *Cheilocystidia* 50–70 × 12–20 μm, similar to pleurocystidia, at times ochraceous, mixed with clavate to subelliptic paracystidia that are hyaline and thin-walled; occasional basidia observed. *Stipitipellis* with caulocystidia descending near the stipe base, these similar to cheilocystidia and pleurocystidia but also lageniform and at times with subcapitate apices (like *I. emergens*) or thin-walled, less frequent on lower half of stipe but mixed with cauloparacystidia; refractive hyphae and pigment deposits frequent in stipe trama. *Pileipellis* a cutis of regular hyphae, these cylindrical, yellowish brown or ‘Ochraceous–Tawny’ in mass, mostly 7–13 μm wide, lightly encrusted, thin-walled. *Clamp connections* present in all tissues. (Figures 7, 8)

Distribution and habitat. On ground under *Allocasuarina* in the central wheatbelt region of Western Australia. Fruiting June, July.

Other specimens examined. [arranged chronologically] WESTERN AUSTRALIA. Old dismantled Kunjin railway, about 14 km W of Corrigin, solitary near planted eucalypts and *Allocasuarina* bushes, 26 July 2011, *N.L. Bougher* 00874 (PERTH 08320578); Vinegar Well, off Barber Rd, Kunjin, 20 km W of Corrigin, scattered and often deeply buried in sand, under *Allocasuarina*, 27 July 2011, *P.B. Matheny* PBM 3686 (TENN 066548, PERTH 08318999).

Etymology. From the Latin *sinuosus* (sinuate) referring to the outline of the spores of this species, and *spora* (spore).

Notes. *Inocybe sinuospora* and *I. emergens* are similar in several ways. Their fruit bodies are similar in general appearance (compare Figures 1, 7). They are sympatric at least in some locations in the central wheatbelt of Western Australia, in fragmented remnants of native woodland highly modified due to agricultural practices and increasing salinity. Indeed, phylogenetic analyses support a close but distinct relationship between the species (Matheny *et al.* 2009). An ITS sequence from the holotype of *I. sinuospora* differs at a minimum of 40 nucleotide positions (94% similarity, not including gaps) from *I. emergens* (PERTH 07659903), reinforcing their taxonomic separation. Other differences between these two species include the stipe of *I. sinuospora* which lacks the distinct marginate bulb typical of *I. emergens*. Also, the two species are most readily distinguished microscopically, as the spores of *I. sinuospora* have a sinuous outline whereas those of *I. emergens* are angular to nodulose (compare Figures 2, 8). *Inocybe sinuospora* shares some similarities with *I. casuarinae* Corner & E. Horak from Malaysia. Both fungi are associated with Casuarinaceae (*Casuarina* and *Allocasuarina* respectively), and they share a similar spore outline. However the spores of *I. casuarinae* are much shorter (6.5–9 × 4–5 μm) than those of *I. sinuospora* (Horak 1980).



Figure 7. Basidiomes of *Inocybe sinuospora*. A – PERTH 07606532; B – PERTH 08318999.

Inocybe torresiae Matheny, Bougher & M.D.Barrett, *sp. nov.*

Typus: Beverley Springs Station Homestead, Kimberley region, Western Australia, solitary or rarely caespitose on rich black soil in monsoon forest of *Antidesma ghaesembilla* and *Glochidion disparipes* with *Eucalyptus bigalerita*, *Corymbia bella*, and *Albizia procera* more distant, 12 February 1996, M.D. Barrett MDB F70/96, E6978, PBM2157 (*holo*: PERTH 07678428); JQ085937-ITS, EU600872-*rpb1*, EU600873-*rpb2*, EU600874-nLSU.

Mycobank. MB 564192.

Pileus 28–35 mm diam., conical at first but becoming campanulate or applanate with an abrupt pronounced umbo; margin incurved to decurved; surface dry, appressed-fibrillose, excoriate or diffracted-scaly in age with an entire margin, the scales concolorous with background; colour pale yellowish brown or isabelline (4B6–4B5) to pale tan (5B4), possibly darker or tawny brown by maturity (6D6); context pallid, not changing colour where bruised. *Lamellae* adnate, moderately close, about 26 L with several

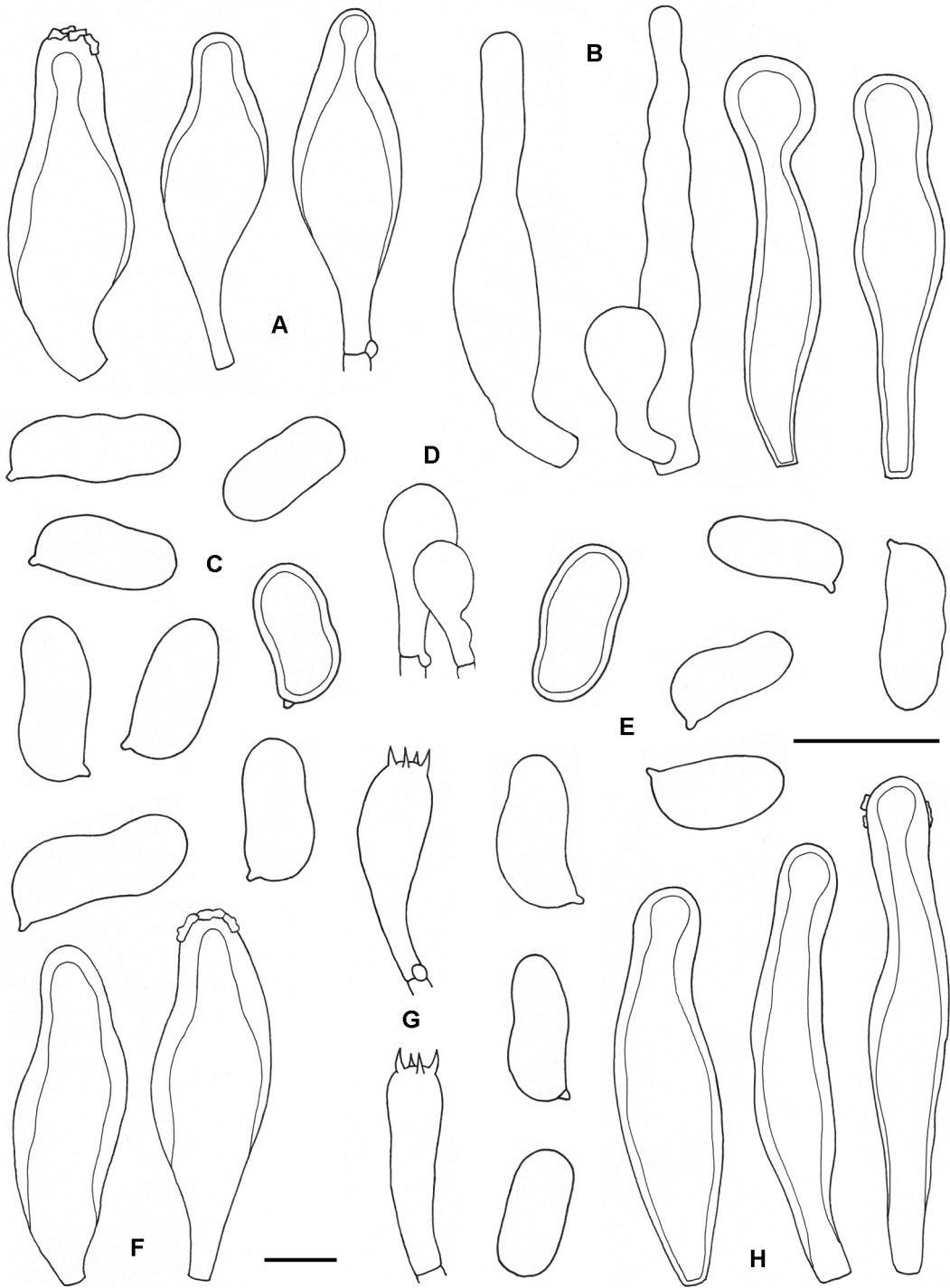


Figure 8. Micromorphology of *Inocybe sinuospora* (A, D – G PERTH 07606532; B, C, H TENN 066548). A – cheilocystidia; B – caulocystidia, caulocystidioid hairs and cauloparacystidium; C – spores; D – paracystidia; E – spores; F – pleurocystidia; G – basidia; H – pleurocystidia. Scale bars = 10 μ m (longer bar for spores only).

tiers of lamellulae, light yellowish brown (4B4) to fawn-coloured (5B4) maturing to brown (6D7) in age, 4–5 mm broad; edges pallid and indistinctly fimbriate. *Stipe* 40–60 × 4–5 mm, even, cylindric, central, the base not bulbous but occasionally swollen-angular; surface pruinose the entire length with a longitudinally striate appearance; cortina none; colour pallid to pale isabelline (4A3–4B3), lighter than the pileus; context solid. *Odour* sharp and sweet, or fruity-soapy (similar to orange extract or citrus hand cleaner). *Taste* not recorded. *Spore deposit* snuff brown (6E6–6E8).

Basidiospores 6.5–8.5 × 4.5–6.0 μm, mean 7.2 × 5.2 μm, Q: (1.17–) 1.27–1.56, Q mean 1.39 (n=36/3), gibbous about a pentagonal to subtrapeziform outline, with 7–10 small obtusely and sharply conical nodules (up to 2 μm tall), often with a small apical nodule, some spores thick-walled, yellowish brown in KOH; apiculus indistinct. *Basidia* 22–32 × 6–8 μm, 4-sterigmate, slender-clavate, hyaline. *Pleurocystidia* 34–61 × 11–21 μm, frequent, subcylindric to subfusiform, sessile at the base, at times rounded-truncate but embedded firmly within the hymenium; necks short or none; apices obtuse and crystalliferous; walls 2.0–3.0 μm thick, hyaline or sometimes with ochraceous contents. *Cheilocystidia* 36–90 × 11–15 μm, subcylindric, subfusiform, slender-lageniform, sessile or rounded at the base, sometimes ochraceous when collapsed, mixed with basidia. *Stipitipellis* composed of caulocystidia descending the entire length or at least to the mid-region of the stipe and less frequent on the lower part, mostly lageniform with a tapered or sessile base or cylindric, and mixed with clusters of cauloparacystidia, at times the lower part of the stipe with caulocystidioid cells only. *Pileipellis* a cutis of cylindric hyphae,

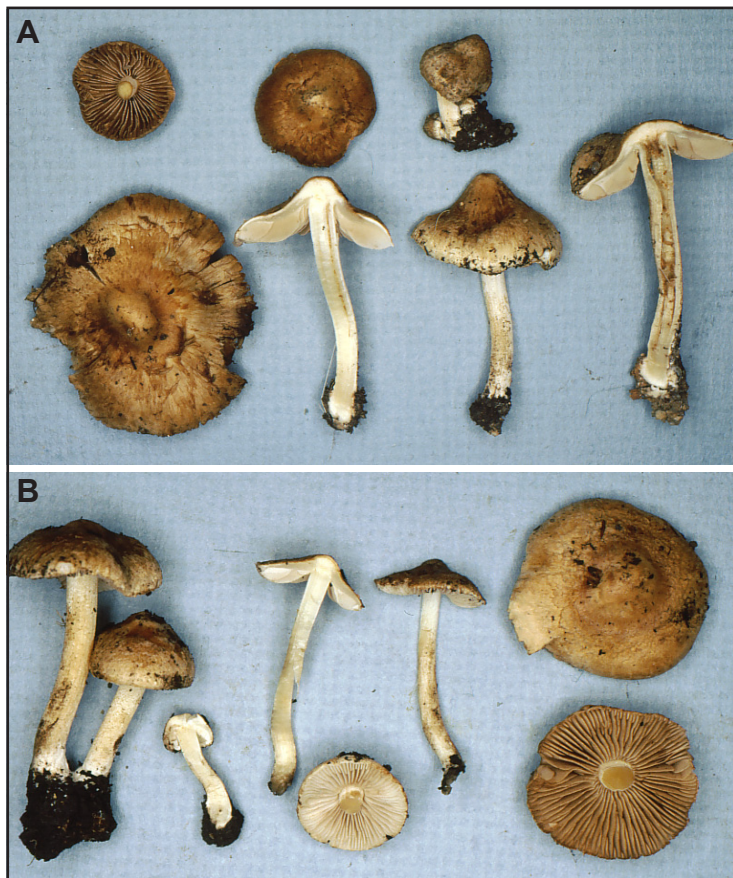


Figure 9. Basidiomes of *Inocybe torresiae*. A – PERTH 07660529; B – PERTH 07554192.

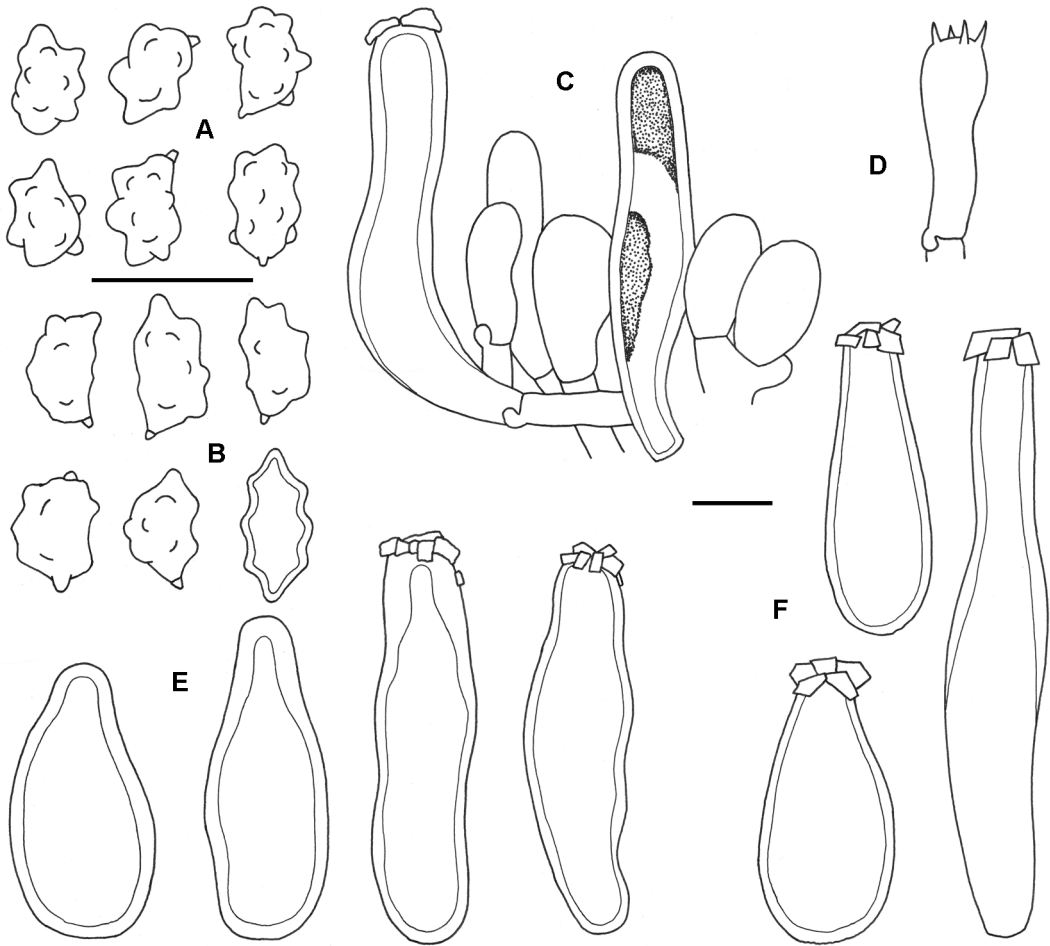


Figure 10. Micromorphology of *Inocybe torresiae* (All PERTH 07678428 except B). A – spores; B – spores (PERTH 07655886); C – Caulocystidia and cauloparacystidia; D – basidium; E – pleurocystidia; F – cheilocystidia. Scale bars = 10 μ m (longer bar for spores only).

these up to 11 μ m diam., yellowish brown in mass, faintly encrusted, thin-walled. *Clamp connections* present in all tissues. (Figures 9, 10)

Other specimens examined. [arranged chronologically] QUEENSLAND. Paluma, Mt Spec area, under *Allocasuarina littoralis* and *Eucalyptus grandis*, 26 Apr. 1990, *N.L. Bougher* E4283 (PERTH 07655886); Murray Range, 5 km out of Koombah toward Yarrabah along Yarrabah Rd, Cairns, on side of soil bank in forest dominated by *Allocasuarina littoralis* and *Acacia auriculiformis*, 20 Feb. 1993, *N.L. Bougher* E4842 (PERTH 07660529); 6.5 km along Rifle Range Rd, S of Atherton, in grassy woodland dominated by *Allocasuarina littoralis*, *Syncarpia*, and *Eucalyptus grandis*, 23 Feb. 1993, *N.L. Bougher* E4867 (PERTH 07554192).

Distribution and habitat. In tropical forests of northern Australia dominated by *Allocasuarina*, *Eucalyptus*, or *Acacia*, or with *Antidesma* and *Glochidion* (Phyllantaceae) and with myrtaceous plants more distant. Fruiting February and April.

Etymology. From the Latin *torresiae*, of the Torresian Province (forested northern Australia).

Notes. *Inocybe torresiae* is a tropical species known only from northern Australia and is distinctive by virtue of its sweet or citrine-like odour. This odour was conspicuous in the Western Australian material (holotype). However, the uniformity of this odour for the species is yet to be confirmed. One of the three Queensland collections was recorded as having a ‘mushroom’ odour, and the odour for other collections was not recorded. *Inocybe torresiae* is also remarkable for the peculiar type of hymenial cystidia that are mostly sessile, rounded-truncate at the base, and firmly embedded within the hymenium (Figures 10 E, F). This feature, as well as the small nodulose spores, unifies all collections cited above. Caulocystidia are present the entire length of the stipe or at least to the mid-region in all collections. Spores of the Queensland collections of *I. torresiae* are slightly more angular with sharper nodules than spores of the type from Western Australia (compare Figures 10A, 10B).

This species was previously referred to as ‘*Inocybe torresia*’ nom. prov. in Matheny *et al.* (2009) where, phylogenetically, it is isolated from other austral taxa but appears to be most closely related to unclarified or undescribed species from tropical Papua New Guinea and Thailand. More broadly, *I. torresiae* has some morphological characteristics suggesting an affinity to sect. *Petiginosae* Heim, e.g. the round-based cystidia. *Inocybe torresiae* may be associated with a diverse range of ectomycorrhizal host plants. For the Western Australian collection, an association with Phyllanthaceae (*Antidesma* and *Glochidion*) hosts may be possible, although myrtaceous plants were noted as ‘more distant’. In Queensland, *Allocasuarina littoralis* was present for all of the collections, but other ectomycorrhizal plants such as *Eucalyptus grandis*, *Acacia* and *Syncarpia* were also noted for one or more of the collections.

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