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Authors: Quijada, Luis, Ribes, Miguel, Negrín, Rubén, and Beltrán-Tejera, Esperanza

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LUIS QUIJADA<sup>1\*</sup>, MIGUEL RIBES<sup>2</sup>, RUBÉN NEGRÍN<sup>3</sup> & ESPERANZA BELTRÁN-TEJERA<sup>1</sup>

## Lignicolous species of *Helotiales* associated with major vegetation types in the Canary Islands

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**Abstract:** A historical worldwide overview of the family *Helotiaceae* in a broad sense and a revision of its members in the Canary Islands are presented. Nine lignicolous species are described in detail (*Ascocoryne cylichnium*, *A. sarcoides*, *Chlorociboria aeruginascens*, *Cyathicula cyathoidea*, *C. hysterioides*, *Durella connivens*, *Pseudohelotium sordidulum*, *Strossmayeria basitricha* and *Velutarina rufoolivacea*). The species of the genus *Ascocoryne* are revised and corrected. The genera *Durella*, *Pseudohelotium* and *Velutarina* are reported for first time for the Canary Islands, each with one species, as is *Cyathicula hysterioides*. Species considered closely related are briefly discussed.

**Key words:** *Ascomycota*, Canary Islands, diversity, *Helotiales*, *Leotiomycetes*, Macaronesia, taxonomy

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### Introduction

*Helotium* Pers. (1801) is the type genus of *Helotiaceae*, a family established by Rehm (1896) as “Familie *Helotieae*”, later correctly spelled by Lindau (1893). In his concept, Rehm split the family into two groups: (1) “*Euhelotieae*” without hairs, and (2) “*Trichopezizeae*” with hairs. Despite the quality of his work, his classification was avoided by subsequent researchers, mainly because he did not accept distinctions made previously by other authors, particularly the difference between inoperculate and operculate asci (Boudier 1885).

Since the family *Helotiaceae* was established, several nomenclatural problems have arisen due to the type genus *Helotium* Pers. (1801) vs *Helotium* Tode (1790) : Fr. (= *Omphalina* Quél.). Korf (in Ainsworth & al. 1973), in his revision of discomycetes, realized the illegitimacy

problem of *Helotiaceae*, and decided to use instead the name *Leotiaceae* Corda (1842), a family with only one genus (*Leotia* Pers.), previously included in *Geoglossaceae* Corda. Not all authors accepted *Leotiaceae* as Korf suggested, and between 1944 and 1996 morphological and molecular evidence (Chadefaud 1944; Verkley 1994, 1995; Gargas & Taylor 1995; Landvik 1996) turned out to support the opinion that *Leotia* was clearly different from all other genera of inoperculate discomycetes treated traditionally in *Helotiaceae*. Later, Korf & al. (1996) proposed to conserve the family name *Helotiaceae* against the earlier names *Bulgariaceae* Fr., *Cenangiaceae* Rehm, *Cordieritidaceae* (Sacc.) Sacc. and *Heterosphaeriaceae* Rehm and also suggested that *Leotiaceae* should not be synonymized with *Helotiaceae*. In a Report of the Nomenclature Committee for Fungi (Gams 1999), Korf & al.’s proposal was reported as having received only

1 Department of Botany, Ecology and Plant Physiology, University of La Laguna, 38071 La Laguna, Tenerife, Canary Islands, Spain; \*e-mail: [lquijull@gmail.com](mailto:lquijull@gmail.com) (author for correspondence); [ebeltran@ull.edu.es](mailto:ebeltran@ull.edu.es)

2 Avenida Pablo Neruda 120, 28018 Madrid, Spain; e-mail: [miguelangel.ribes@gmail.com](mailto:miguelangel.ribes@gmail.com)

3 Sorondongo 24, 38205 La Laguna, Tenerife, Canary Islands, Spain; e-mail: [lasorijamas@hotmail.com](mailto:lasorijamas@hotmail.com)

positive votes; therefore the conservation of *Helotiaceae* against the four older family names was recommended.

Until very recently, the morphological concept used to circumscribe *Helotiaceae* was more or less the same as that used in the past century (Nannfeldt 1932), and *Helotiaceae* comprised 117 genera and 826 species (Kirk & al. 2008). General books on *Ascomycota* with keys to members of *Helotiales* (Korf in Ainsworth & al. 1973; Dennis 1978; Hansen & Knudsen 2000; Pande 2008) have one detail in common: the family is always placed in the last step of the key. Curiously, these keys lead us to all the other families thanks to morphological characteristics, but we arrive at *Helotiaceae* only after discarding all the other families. This is clear evidence for a “waste basket” family, which includes a lot of helotialean genera with uncertain position. Molecular tools have evidenced this waste basket nature: Wang & al. (2006) showed for the first time that genera considered to belong in *Helotiaceae* were distributed in seven different clades, and none of the supported clades was called *Helotiaceae*. Later phylogenies with members of the family confirmed this result (Han & al. 2014; Johnston & al. 2014). Very recently, Baral (2016) proposed a much narrower concept of the family *Helotiaceae*, which has reduced the number of accepted genera to 18 and is based on a combination of morphological and phylogenetic affinities. Up to now, general databases such as Index Fungorum or MycoBank have not adopted these systematic changes. In the present paper, we have treated the family in its broader concept (*Helotiaceae* s.l.) by including all the above-mentioned families.

The aim of this work is to contribute to the knowledge of *Helotiaceae* s.l. in the Canary Islands, where nine genera and 12 species have been reported (Beltrán-Tejera 2010). Some genera and species are presently under study and were previously confused within this archipelago: (1) *Hymenoscyphus albidus* (Gillet) W. Phillips turned out to include also *H. calyculus* (Fr.) W. Phillips; (2) *Claussenomyces* Kirschst. is not placed in *Helotiaceae* but in *Tympanidaceae* (for more details see Baral 2015, 2016); (3) the collection reported under *Tympanis confusa* Nyl. actually belongs to *Claussenomyces*; and (4) great confusion exists with the genus *Xylogramma* Wallr.; for more details see remarks under *Durella conivens* (Fr.) Rehm. For these reasons, the following species reported to the Canarian archipelago have not been included in this work and will be published separately in other papers in preparation: *Claussenomyces canariensis* Ouell. & Korf, *Hymenoscyphus albidus*, *H. caudatus* (P. Karst.) Dennis, *H. macroguttatus* Baral & al., *Tympanis confusa* and *Xylogramma sticticum* (Fr.) Wallr.

## Material and methods

Descriptions of sampled vegetation and methods to study the collections are based on Quijada & al. (2015). All samples were collected on wood and/or bark of detached

branches. All specimens were photographed in the fresh state. Distribution of treated species was explored using the literature cited in the References of this article, as well as The Global Biodiversity Information Facility (GBIF, <http://www.gbif.org/>). Specimens are deposited in the Mycological Section, Herbarium of the University of La Laguna (TFC). Colour coding refers to Anonymous (1976). Municipalities and place names for localities were looked up in IDECanarias visor 3.0 (<http://visor.grafcn.es/visorweb/>).

Abbreviations: \* = living state; † = dead state; CR = aqueous congo red; CRB = aqueous cresyl blue; H<sub>2</sub>O = water; idem = the same; IKI+ = pore amyloid in MLZ or LUG with or without KOH pre-treatment; KOH = potassium hydroxide; LBs = lipid bodies; LCI = lipid content index according to Baral & Marson (2005); LUG = Lugol's solution; MLZ = Melzer's reagent; *t.* = *textura*; VBs = vacuolar bodies.

Main collectors: CQ = Camilo Quijada; EBT = Esperanza Beltrán-Tejera; LQ = Luis Quijada; MR = Miguel Ribes; RN = Rubén Negrín.

## Results

*Ascocoryne cylichnium* (Tul.) Korf in Phytologia 21: 202. 1971. – Fig. 1.

*Description* — Apothecia 2–5(–6) mm in diam., to 2 mm high, discoid to cupulate with narrow attachment, disc depressed at centre, sparse to gregarious, superficial, sessile, medium red-brown (43.m.rBr) to vivid deep red (14.v.deepRed), margin smooth and slightly lobate; receptacle with a wrinkled and slightly white dusty surface. Asci \*(147.5–)154–162.5(–167.5) × 10–11.3(–12) µm, †(106–)114–127 × 6–8 µm; cylindrical-clavate, 8-spored, 2-seriate, *pars sporifera* \*41–58.5 µm, IKI+; arising from croziers. Ascospores \*(14–)16–17.5(–18.5) × 4.5–5.5 µm, †12.5–16 × 2–4 µm; ellipsoid to fusoid, straight to rarely slightly curved, inequilateral, 0–3-septate (aseptate in living ascus), hyaline, thin-walled, multiguttulate, containing many small LBs, LCI = (45–)60–75(–90)%; after release or inside dead asci producing globose to ellipsoid conidia of \*1.5–2 × 1.3–1.8 µm directly from ascospore wall, not forming moniliform chains. Paraphyses slightly to strongly capitate, 3- or 4-septate; terminal cell \*19–32 × 3.5–5 µm, basal cell \*13–18 × 1.1–1.5 µm; simple to rarely bifurcate near base, thin-walled, with one or several large yellowish grey (93.yGrey) guttules in terminal cell (VBs). Ectal excipulum from base to margin of *t. globulosa-angularis* to *prismatica*, \*170–240 µm thick at base and middle flanks; \*30–110 µm thick at margin and upper flank; hyaline to light grey-red-brown (45.l.gy.rBr), slightly gelatinized, with abundant crystals and druses. Ectal cells \*(15–)22–30(–44) × (8.5–)15–19(–24) µm at middle flank, wall thickness \*0.5–1 µm; \*(9.5–)11.5–13(–16.5)

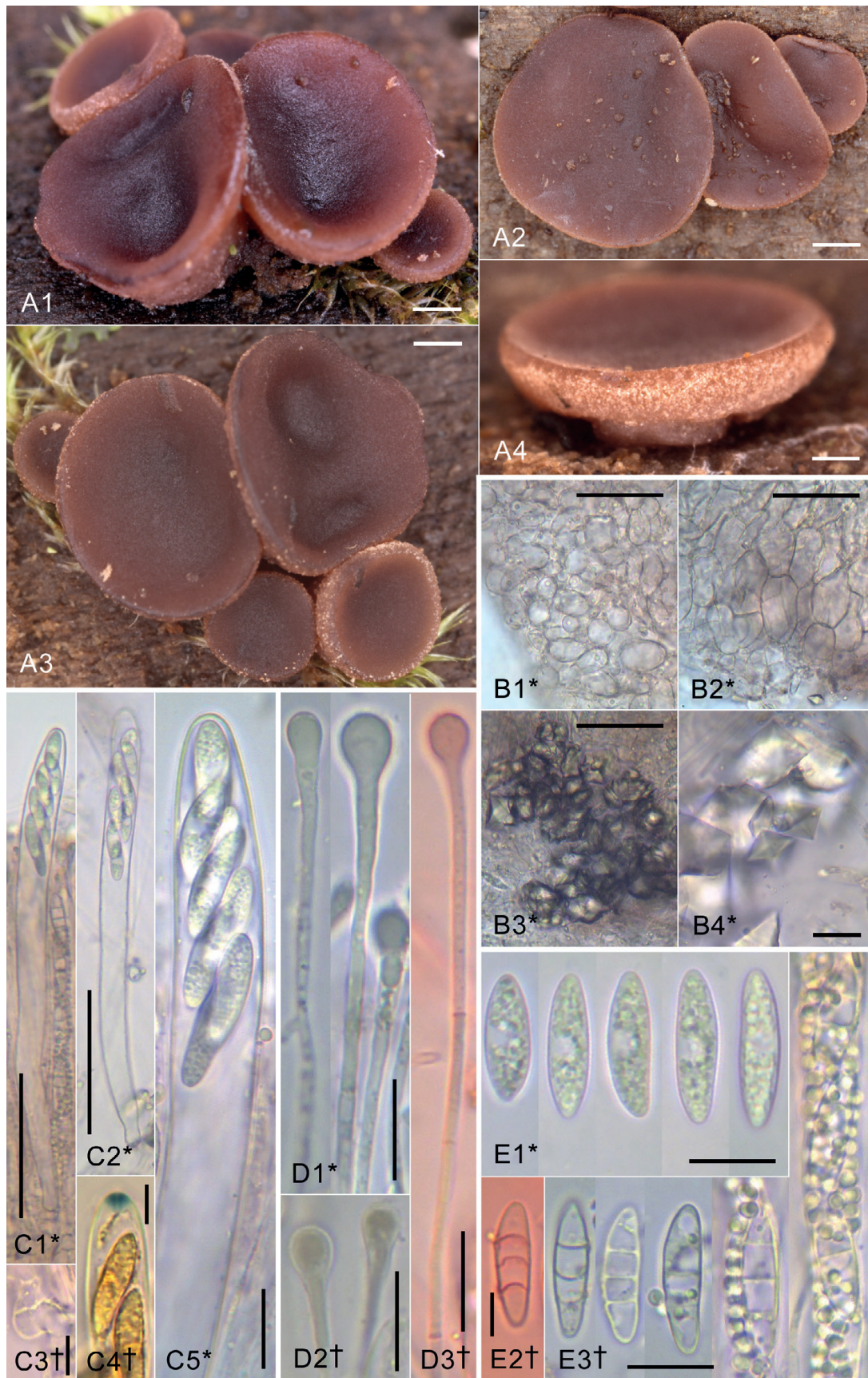


Fig. 1. Morphological features of *Ascocoryne cylichnium*. – A: apothecia; B: excipular tissues in section; B3, 4: crystals and druses; C: asci; D: paraphyses; E: ascospores. – Scale bars: A1–4 = 1000  $\mu$ m; B1–3, C1, 2 = 50  $\mu$ m; B4, C5, D1–3, E1, 3 = 10  $\mu$ m; C3, 4, E2 = 5  $\mu$ m. – Mounted in: D3, E2 = CR; B1–4, C1–3, 5, D1, E1 = H<sub>2</sub>O; D2, E3 = KOH; C4 = MLZ. – All photos from TFC Mic. 20608.

× (5–)8.5–10.5(–14) µm at margin. Medullary excipulum with rather wide hyphae and slightly gelatinized.

*Distribution and ecology* — In the N hemisphere in the Canary Islands (La Palma, Tenerife), Madeira, Europe (Austria, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom), Asia (China, India, Japan, Korea, Taiwan) and North America (Canada, United States). In the S hemisphere in New Zealand and South America (Argentina, Chile). Growing on hardwood (*Alnus* Mill., *Betula* L., *Carpinus* L., *Erica* L., *Fagus* L., *Fraxinus* Tourn. ex L., *Nothofagus* Blume, *Prunus* L., *Quercus* L., *Salix* L., *Sorbus* L., *Tilia* L., *Ulmus* L.) and softwoods (*Picea* A. Dietr., *Pinus* L., *Pseudotsuga* Carrière). Occurring in all seasons, more abundantly in autumn (Beltrán-Tejera & al. 2009; Dennis 1956; Gamundí & Romero 1998; GBIF; Hansen & Knudsen 2000; Roll-Hansen & Roll-Hansen 1979).

*Remarks* — *Ascocoryne cylichnium* is one of the most frequently reported taxa in *Helotiales* (more than 1400 occurrences in GBIF). Although there exists a great confusion in the literature about *A. cylichnium* and *A. sarcoides*, Baral (in Baral & Marson 2005) showed striking differences between these two species based on vital taxonomy. *Ascocoryne cylichnium* can be differentiated based on its excipular tissues, showing an only slightly gelatinized medullary excipulum of broad hyphae, which includes crystals and druses (Fig. 1B3–4), the presence of many small lipid bodies in the ascospores (multiguttulate), and conidia produced directly on the ascospore wall without forming chains (compare Fig. 1E3 against Fig. 2E4–7). In the last classification proposed by Baral (2016) for *Leotiomycetes*, the genus was placed in the family *Gelatinodiscaceae*; for molecular details see Wang & al. (2006) and Johnston & al. (2014).

*Specimens studied* — SPAIN: CANARY ISLANDS: LA PALMA: San Andrés y Sauces, 28°46'35"N, 17°48'58"W, 825 m, hygic evergreen laurel forest, on unidentified wood, 28 Jan 1989, *EBT & al.* (TFC Mic. 3413). — TENERIFE: Santa Cruz de Tenerife, Anaga Rural Park, Llanito de las Vueltas, 28°32'37"N, 16°13'36"W, 820 m, humid evergreen laurel forest, on detached wood of *Prunus lusitanica* subsp. *hixa*, 26 Apr 2014, *RN* (TFC Mic. 20608); idem, El Pijaral, 28°33'11"N, 16°11'18"W, 775 m, idem, 19 Feb 2011, *LQ & al.* (TFC Mic. 23124); idem, 17 Oct 2014, *LQ, CQ & RN* (TFC Mic. 21430); idem, on detached wood of *Erica arborea*, idem (TFC Mic. 21486).

*Previously reported specimens reviewed and corrected* — SPAIN: CANARY ISLANDS: TENERIFE: Los Silos, Teno Rural Park, La Corredera, 28°20'09"N, 16°49'45"W, 880 m, humid evergreen laurel forest, on unidentified

wood, 21 Mar 1988, *EBT & al.* (TFC Mic. 3177, reported as *Ascocoryne sarcoides* in Beltrán-Tejera & al. 1989).

*Ascocoryne sarcoides* (Jacq.) J. W. Groves & D. E. Wilson in *Taxon* 16: 40. 1967. – Fig. 2.

*Description* — Apothecia 0.3–0.8 mm in diam., to 3 mm high, discoid to turbinate with broad attachment to shortly stipitate, caespitose (1–3 discs from same stipe), sparse to gregarious, gelatinous, superficial, medium pink (5.m.Pink) to deep purple-red (259.d.pR), margin smooth and slightly lobate; receptacle with wrinkled surface, stipe usually darker, vivid deep purple-red (260.v.d.pR) to black (267.Black). Asci \*(146.6–)159–179(–194) × (10–)11–12.5 µm, †107–128 × 7.7–8.6 µm; cylindric-clavate, 8-spored, 2-seriate, *pars sporifera* \*35–67 µm, IKI+; arising from croziers. Ascospores \*(11.8–)13.8–15(–19) × (2.8–)4.6–5.7 µm, †(10.8–)11.8–13.5(–16.3) × 3–5 µm; ellipsoid to subcylindric, straight to slightly inequilateral, 0–3-septate, hyaline, thin-walled, oligo- and multiguttulate (LBs), two large guttules (1.7–3 µm in diam.) surrounded by a great number of small drops (0.3–0.7 µm in diam.), LCI = (20–)30–45(–60)%; after release or into dead asci producing globose to obovoid conidia from germ tubes, usually located at both poles, conidia \*2.1–2.8(–3.5) × 1.8–2.3 µm, forming moniliform chain. Paraphyses slightly to medium capitate or spatulate to sublageniform-moniliform, 5–7-septate; terminal cell \*(11.8–)14.6–19.4(–23.6) × 1.8–2.6(–3.4) µm, basal cell \*(6.1–)9.7–13.7(–20.4) × 1.4–2.2 µm; unbranched, thin-walled, with one or several large light grey (264.l.Grey) guttula at terminal cell (VBs). Ectal excipulum from base to margin of *t. globulosa* to *t. angular*, \*148–342 µm thick at base and middle flanks; \*65–173 µm thick at margin and upper flank; hyaline, medullary well delimited in a gelatinized *t. intricata*, without crystals or druses. Ectal cells \*(10.3–)12.3–14(–18.5) × (6.2–)8–9.7(–13.4) µm at middle flank, \*(5.8–)8.3–10(–15) × (3.4–)4–4.8(–5.8) µm at margin, wall thickness \*0.3–0.8 µm.

*Distribution and ecology* — In the N hemisphere in the Canary Islands (Tenerife), Europe (Austria, Bosnia and Herzegovina, Czech Republic, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom), Africa (Algeria, Morocco, São Tomé und Príncipe), Asia (China, Georgia, Japan), North America (Canada, United States), Central America (Costa Rica, Cuba, Grenada, Jamaica) and South America (Colombia, Guyana). In the S hemisphere in Africa (Madagascar, South Africa without locality), Tristan da Cunha, Australia, New Zealand and South America (Argentina, Brazil, Chile). Growing on hardwoods (*Acer* L., *Alnus*, *Betula*, *Carpinus*, *Corylus* L., *Crataegus* L., *Eucalyptus* L'Hér., *Fagus*, *Fraxinus*,

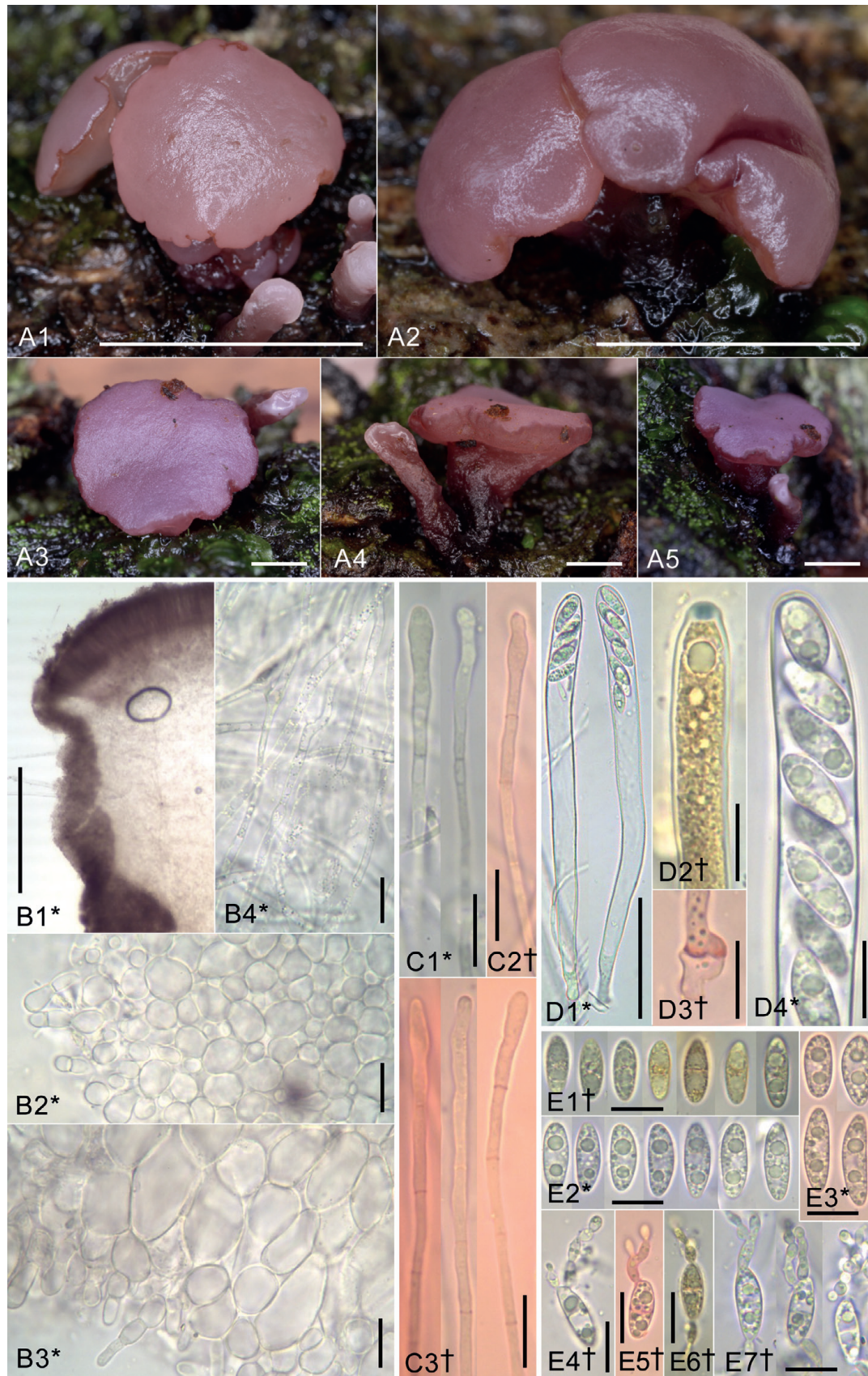


Fig. 2. Morphological features of *Ascocoryne sarcoides*. – A: apothecia; B: excipular tissues in section; C: paraphyses; D: asci; E: ascospores. – Scale bars: A1, 2, B1 = 500  $\mu$ m; A3–5 = 100  $\mu$ m; B2–4, C1–3, D1–4, E1–7 = 10  $\mu$ m. – Mounted in: C2, 3, D3, E3, 5 = CR; B1–4, C1, D1, 4, E2, 4, 7 = H<sub>2</sub>O; D2, E1, 6 = MLZ. – Photos from: A3–5, B2–4, C1–3, D2–4, E1–6 = TFC Mic. 22699; A1, 2, B1, D1, E7 = Negrín herb. 220215.

*Laurus* L., *Malus* Mill., *Nothofagus*, *Populus* L., *Prunus*, *Pterocarya* Kunth, *Quercus*, *Salix*, *Sorbus*, *Tilia*) and softwoods (*Picea*, *Pinus*). Occurring in all seasons, more abundantly in autumn (Dennis 1956, 1986; GBIF; Gamundí & Romero 1998; Hansen & Knudsen 2000; Roll-Hansen & Roll-Hansen 1979).

**Remarks** — *Ascocoryne sarcoides* is different from *A. cylichnium* and *A. striata* (Ellis & Everh.) V. Kučera & Lizoň in that it does not present oxalate crystals in the excipulum (Roll-Hansen & Roll-Hansen 1979; Kučera & Lizoň 2005). *Ascocoryne microspora* (Ellis & Everh.) Korf has shorter ascospores (5–6 µm) (Ellis & Everhart 1897). *Ascocoryne solitaria* (Rehm) Dennis was differentiated from *A. sarcoides* by its obtuse spores, brown excipulum and lack of purple pigment (Dennis 1971). *Ascocoryne turficola* (Boud.) Korf differs in its ecology and morphology (Stasińska & Sotek 2004). Two species have drawn our attention, *A. javanica* (Penz. & Sacc.) K. S. Thind & H. Singh and *A. trichophora* (A. L. Sm.) Seifert; both cannot be clearly differentiated from *A. sarcoides*, neither with biometry (Penzig & Saccardo 1902; Seifert 1989) nor using morphology, but to be sure about their synonymization a further morpho-biometric study will be necessary.

**Specimens studied** — SPAIN: CANARY ISLANDS: TENERIFE: La Laguna, Anaga Rural Park, Cuadras de Don Benito, 28°32'12"N, 16°18'05"W, 845 m, humid evergreen laurel forest, on *Prunus lusitanica* subsp. *hixa*, 26 Jan 2015, RN (TFC Mic. 22699); idem, 22 Feb 2015, idem (Negrín herb. 220215).

***Chlorociboria aeruginascens*** (Nyl.) Kanouse ex C. S. Ramamurthi & al. in *Mycologia* 49: 858. 1958. – Fig. 3.

**Description** — Apothecia 1.5–5 mm in diam., 2–3.8 mm high, cupulate-stipitate, scattered to gregarious (caespitose), stipes of different fruit bodies arising from same point, fleshy, superficial, disc light blue-green (163.l.bG) to strong blue-green (160.s.bG), margin smooth, slightly lobate in larger apothecia; receptacle concolorous but usually covered by a white velvet, darker at base, vivid deep green-blue (175.v.v.gB). Asci \*(57.3–)65–72.5(–76) × 4.3–5 µm, †(50–)53–55.7(–57) × 3.3–4 µm; cylindrical-clavate, 8-spored, 2-seriate, *pars sporifera* \*18–22 µm, IKI+; arising from croziers. Ascospores \*(6.6–)7.4–8(–8.7) × 1.7–2 µm, †(5.5–)6–7(–8) × 1–1.8 µm; subcylindric, straight to slightly inequilateral, without septa, hyaline, thin-walled, with 3–6 drops (LBs, 0.4–1 µm in diam.), LCI = (7–)12–20(–30)%. Paraphyses uninflated, cylindrical to subanceolate, 3- or 4-septate; terminal cell \*(14.8–)16.8–20.5(–27.4) × 2–2.7 µm, basal cell \*(10–)11.4–12.6(–14.5) × 1.7–2.8 µm; simple or branched at lower cells, thin-walled, without drops, apical cell usually covered by a thin amorphous medium green (145.m.G) layer of exudates. Ec-

tal excipulum at base to lower flank *t. epidermoidea*, \*148–188 µm thick, at margin and upper flanks *t. prismatica* to *t. porrecta*; \*44–135 µm thick at margin and upper flank; light blue-green (163.l.bG), medullary excipulum well delimited in a gelatinized and hyaline *t. intricata*, without crystals or exudates. Ectal cells \*(9–)12–14.8(–18) × (3.8–)4.7–6(–7.3) µm at middle flank, wall thickness \*0.4–0.9 µm; \*(6–)7.4–8.6(–10.4) × (2.3–)3.3–4(–4.5) µm at margin. Protruding hyphae-like hairs, hyaline and coiled, present at upper flank at margin, \*14–29 × 0.9–1.4 µm.

**Distribution and ecology** — In the N hemisphere in the Canary Islands (Gomera, La Palma, Tenerife), Europe (Andorra, Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Latvia, Luxembourg, Norway, Portugal, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom), Africa (N Africa without locality), Asia (China, India, Japan, Kuril Islands, Philippines, Republic of Korea, Taiwan), North America (Canada, Greenland, Mexico, United States), Central America (Costa Rica, Cuba, Guatemala) and South America (Guyana). In the S hemisphere in Asia (Papua New Guinea), Australia, New Zealand and South America (Argentina, Brazil, Chile, South Georgia and the South Sandwich Islands). Growing on hardwoods (*Acer* L., *Alnus*, *Apollonias* Nees, *Betula*, *Carpinus*, *Chamaecytisus* Link, *Corylus*, *Dracophyllum* Labill., *Erica*, *Fagus*, *Fraxinus*, *Laurus*, *Metrosideros* Banks ex Gaertn., *Morella* Lour., *Nothofagus*, *Ocotea* Aubl., *Persea* Mill., *Populus*, *Prunus*, *Pseudopanax* K. Koch, *Quercus*, *Salix*, *Tilia*, *Ulmus*, *Weinmannia* L.) and softwood (*Agathis* Salisb.). Occurring in all seasons, more abundantly from summer to autumn (Beltrán-Tejera & al. 1987, 2004, 2008, 2009; Beltrán-Tejera & Wildpret 1975; Dähncke 1998; Dennis 1956, 1986; Gamundí & Romero 1998; GBIF; González & Beltrán-Tejera 1987; Iglesias & al. 2013; Johnston & Park 2005; Martínez 2000).

**Remarks** — *Chlorociboria aeruginascens* is easy to distinguish macroscopically by the presence of white tomentum in the receptacle, the turquoise colour of hymenium, and the common base, with several stipes arising separately; microscopically it is differentiated from other species in the genus by its ascospore measurements and morphology (Dixon 1975; Johnston & Park 2005). In the last classification proposed by Baral (2016) for *Leotiomyces*, the genus was placed in the family *Chlorociboriaceae*; for phylogenetic details see Wang & al. (2006) and Johnston & al. (2014).

**Specimens studied** — SPAIN: CANARY ISLANDS: TENERIFE: Santa Cruz de Tenerife, Anaga Rural Park, Hoya el Viñatigo, 28°31'42"N, 16°16'40"W, 780 m, dry evergreen laurel forest, on *Apollonias barbujana*, 5 Feb 2011, LQ & al. (TFC Mic. 23097, 23108); idem, Tacoronte,

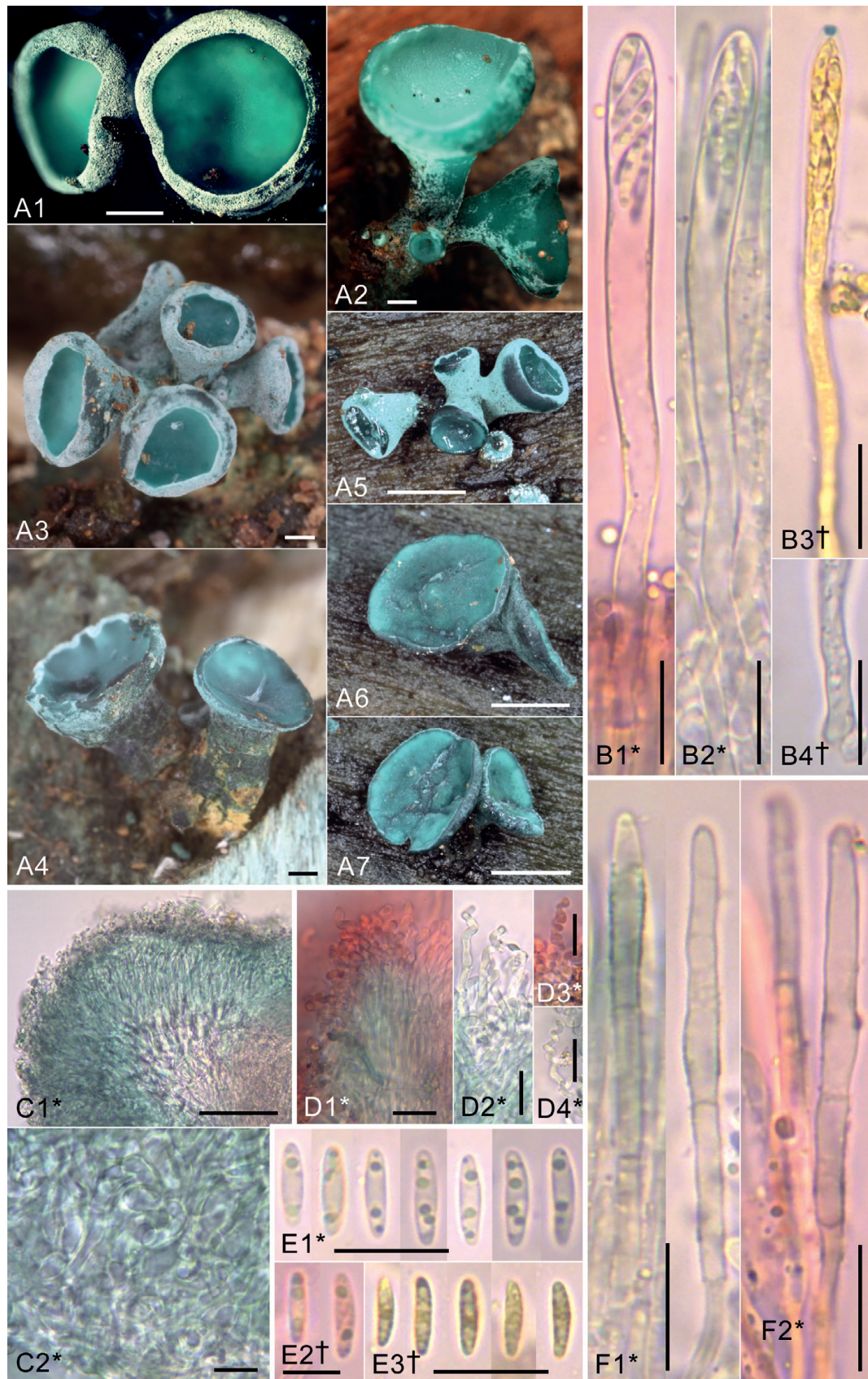


Fig. 3. Morphological features of *Chlorociboria aeruginascens*. – A: apothecia; B: asci; C: excipular tissues in section; D: hairs; E: ascospores; F: paraphyses. – Scale bars: A5–7 = 2.5 mm; A1–4 = 500  $\mu$ m; C1 = 50  $\mu$ m; B1–4, C2, D1–4, E1–3, F1, 2 = 10  $\mu$ m. – Mounted in: B1, D1, 3, E2, F2 = CR; B2, 4, C1, 2, D2, 4, E1, F1 = H<sub>2</sub>O; B3, E3 = MLZ. – Photos from: A1 = TFC Mic. 23404; A2–4, B1–4, C1, 2, D1–4, E1–3, F1, 2 = TFC Mic. 24506; A5–7 = Negrín herb. 25122011.



Agua García, Los Barriales, 28°27'17"N, 16°23'33"W, 945 m, substitutional vegetation "fayal-brezal", on *Persea indica*, 22 Feb 2014, RN (TFC Mic. 24506); idem, Tegueste, Anaga Rural Park, Hoya Zapata, 28°31'51"N, 16°31'51"W, 820 m, humid evergreen laurel forest, idem, 22 Mar 2012, LQ & CQ (TFC Mic. 23404, 23412). — GOMERA: Hermigua, Garajonay National Park, El Palo Labrado, 28°07'37"N, 17°13'15"W, 910 m, idem, on unidentified wood, 25 Dec 2012, RN (Negrín herb. 25122011).

*Cyathicula cyathoidea* (Bull.) Thüm., Fungi Austriaci Exsicc. Cent. 12: no. 1115. 1874. – Fig. 4.

**Description** — Apothecia 0.4–1 mm in diam., 0.4–0.5 mm high, cupulate or discoid, shortly stipitate (stipe to 0.2 mm long), scattered to gregarious, superficial, disc light olive-brown (94.l.OlBr) to medium yellow-brown (77.m.yBr), margin entire to slightly crenulate, with or without whitish protruding hyphae-like hairs; receptacle concolorous. Asci \*(55.4–)70.5–76(–96.6) × (5.4–)6–6.6(–8) µm, †(45.8–)54.5–58.5(–68) × (3.4–)4.6–5(–5.7) µm; cylindrical-clavate, 8-spored, 2-seriate, *pars sporifera* \*20–38 µm, IKI+; arising from simple septa. Ascospores \*(8.7–)10.8–11.5(–15.5) × 2–3.2 µm, †(7–)9–9.6(–12.4) × 1.8–2.3 µm; ellipsoid, subcylindric or fusiform, straight to inequilateral or slightly helicoid, aseptate, hyaline, thin-walled, without drops. Paraphyses uninflated, cylindrical to slightly capitate, 3- or 4-septate; terminal cell \*(17–)22.3–26.4(–33.4) × (2.2–)2.7–3(–4) µm, basal cell \*(8.8–)13.7–17.4(–25) × 1.7–3 µm; simple, thin-walled, filled by greyish yellow (90.gy.Y) tiny drops (LBs, multi-guttulate). Ectal excipulum at base to lower flank *t. oblita*, \*57–111 µm thick, at margin and upper flanks *t. prismatica* to *t. porrecta*; \*14–75 µm thick at margin and upper flank; usually light yellow-brown (77.l.yBr) to medium yellow-brown (77.m.yBr), sometimes darker at margin or upper flank (deep greyish brown (62.d.gy.Br)); medullary excipulum well delimited by a non-gelatinized and hyaline *t. porrecta* to *t. intricata*, outermost layer of cells slightly covered by amorphous resin-like matter or crystals. Ectal cells \*(11–)20–24(–34.5) × (3–)3.6–4(–5.6) µm at middle flank, wall thickness \*0.3–1.5 µm; \*(9–)11.6–13(–17.7) × (2–)2.5–3(–3.7) µm at margin. With or without protruding hyphae-like hairs at margin, walls medium yellow-brown (77.m.yBr) to deep yellow-brown (75.deep.yBr), to \*16 × 3–4 µm, slightly encrusted with bright amorphous resin-like matter or crystals.

**Distribution and ecology** — In the N hemisphere in the Canary Islands (Gomera, Gran Canaria, La Palma, Tenerife), Europe (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Romania, Russian Federation, Slovenia, Spain, Sweden, Switzerland, United Kingdom), Africa (Morocco), Asia (China, India, Japan, Pakistan, Philippines), North

America (Canada, United States) and Central America (Cuba). In the S hemisphere in Asia (Papua New Guinea), Australia, New Zealand and South America (Argentina). Growing on hardwoods (*Adenocarpus* DC., *Castanea* Mill., *Chamaecytisus*, *Fraxinus*, *Phytolacca* L., *Robinia* L., *Sambucus* L., *Sorbus*, *Spartocytisus* Webb & Berthel.), on softwood (*Pinus*), on herbaceous or woody stems (*Aconitum* L., *Actaea* L., *Adenocaulon* Hook., *Adenostyles* Cass., *Aegopodium* L., *Alopecurus* L., *Amaranthus* L., *Angelica* L., *Anthriscus* Pers., *Aquilegia* L., *Arctium* L., *Artemisia* L., *Atropa* L., *Bartsia* L., *Brassica* L., *Bromus* L., *Calamagrostis* Adans., *Campanula* L., *Carduus* L., *Carlina* L., *Centaurea* L., *Cerastium* L., *Cichorium* L., *Cirsium* Mill., *Corydalis* DC, *Dahlia* Cav., *Delphinium* L., *Deschampsia* P. Beauv., *Digitalis* L., *Epilobium* L., *Eupatorium* L., *Filipendula* Mill., *Geum* L., *Helianthus* L., *Heracleum* L., *Holcus* L., *Hyacinthoides* Heist. ex Fabr., *Iris* Tourn. ex L., *Isodon* (Schrud. ex Benth.) Spach, *Lathyrus* L., *Leonurus* L., *Lupinus* L., *Lysimachia* L., *Malva* L., *Matricaria* L., *Melampyrum* L., *Mentha* L., *Mercurialis* L., *Myrrhis* Mill., *Nepeta* L., *Oenanthe* L., *Ononis* L., *Osmorhiza* Raf., *Parnassia* L., *Pastinaca* L., *Pedicularis* L., *Pericallis* D. Don, *Plantago* L., *Polymnia* L., *Pterocephalus* Adans., *Raphanus* L., *Rubus* L., *Rumex* L., *Sasa* Makino & Shibata, *Scirpus* L., *Senecio* L., *Sideritis* L., *Silene* L., *Solanum* L., *Solidago* L., *Sonchus* L., *Spiraea* L., *Stachys* L., *Streptopus* Michx., *Symphytum* L., *Todaroa* Parl., *Trifolium* L., *Tripleurospermum* Sch. Bip., *Umbellularia* (Nees) Nutt., *Urtica* L., *Veratrum* L., *Vicia* L.), on fern rachises (*Lycopodium* L., *Pteridium* Scop.), on dead culms (*Bambusa* Schreb., *Juncus* L., *Phragmites* Adans., *Zea* L.) and on leaves (*Festuca* L., *Pinus*). Occurring in all seasons, more abundantly from spring to autumn (Beltrán-Tejera & al. 2004, 2008; Carpenter 1981; Dennis 1956, 1986; GBIF; Gamundí & Romero 1998; Hansen & Knudsen 2000; Urries 1957).

**Remarks** — In his monograph, Carpenter (1981) explained the taxonomic history of *Cyathicula cyathoidea* and wrote that this species is the most commonly collected and widely distributed in the genus. All our features fit well with *Cyathicula cyathoidea* [= *Crocicreas cyathoideum* (Bull.) S. E. Carp]. *Cyathicula complicata* (P. Karst.) Dennis is similar but the asci are inamyloid. *Cyathicula cacaliae* (Pers.) Dennis differs only in the colour of the medullary excipulum (dark brown, vs. hyaline in *C. cyathoidea*). *Cyathicula coronata* (Bull.) Rehm and *C. pallidum* (Velen.) S. E. Carp. differ in their long-toothed apothecial margin, and larger asci and ascospores (Carpenter 1981). The genus remained included in *Helotiaceae* in the last classification of *Leotiomyces* (Johnston & al. 2014; Baral 2016).

**Specimens studied** — SPAIN: CANARY ISLANDS: TENERIFE: Arafo, Montaña Ismana, 28°22'22"N, 16°27'39"W, 1855 m, typical Canary pine woodland, on *Todaroa montana*, 20 Jun 2014, LQ, RN & MR (TFC Mic. 21093,

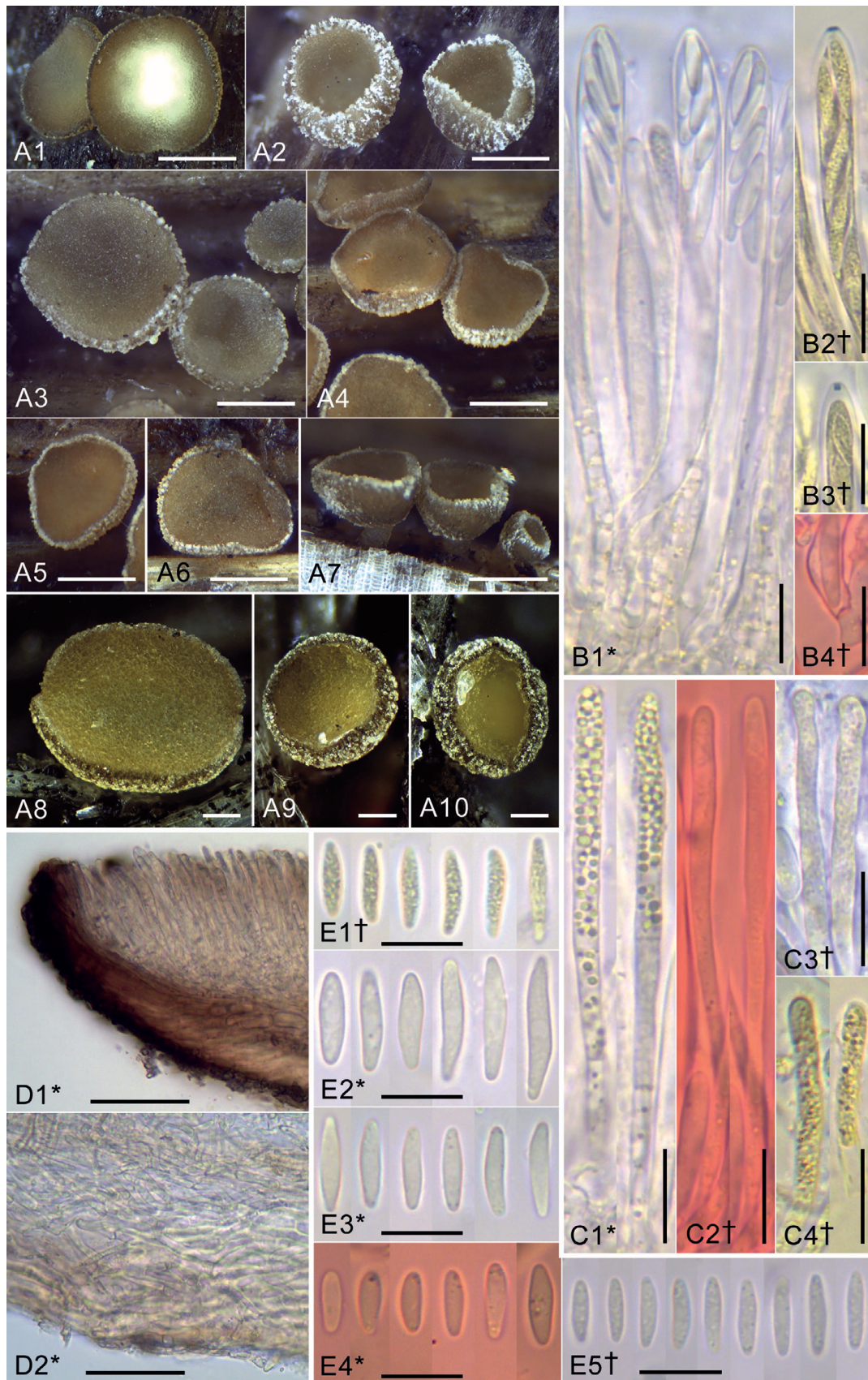


Fig. 4. Morphological features of *Cyathicula cyathoidea*. – A: apothecia; B: asci; C: paraphyses; D: excipular tissues in section; E: ascospores. – Scale bars: A1–7 = 500  $\mu$ m; A8–10 = 100  $\mu$ m; D1, 2 = 50  $\mu$ m; B1–4, C1–4, E1–5 = 10  $\mu$ m. – Mounted in: B4, C2, E4 = CR; B1, C1, D1, 2, E2, 3 = H<sub>2</sub>O; C3, E5 = KOH; B2, 3, C4, E1 = MLZ. – Photos from: A1, B2–4, C2, E1, 2 = TFC Mic. 21093; A2, 3, B1, C1, E5 = TFC Mic. 21094; A4–7, D2, E3 = TFC Mic. 21115; A8–10, C3, 4, D1, E4 = TFC Mic. 24081.

21094, 21115, 21132); idem, Candelaria, Lomo Colorado, 28°24'37"N, 16°24'21"W, 1430 m, humid Canary pine woodland, on *Chamaecytisus proliferus*, 26 Sep 2012, *LQ* & *CQ* (TFC Mic. 23571); idem, Guía de Isora, Teide National Park, El Morro los Cerillos, 28°15'10"N, 16°42'38"W, 2010 m, meso-oromediterranean summit broom scrub, on *Spartocytisus supranubius*, 22 Mar 2014, idem (TFC Mic. 24531); idem, on *Pterocephalus lasiospermus*, idem (TFC Mic. 24530); idem, La Orotava, Cuesta la Burra, 28°18'08"N, 16°34'27"W, 2075 m, idem, on *Spartocytisus supranubius*, 30 Dec 2013, idem (TFC Mic. 24366); idem, Los Lajones, 28°19'51"N, 16°29'37"W, 2060 m, idem, on *Pterocephalus lasiospermus*, 21 Feb 2013, idem (TFC Mic. 23883); idem, on *Spartocytisus supranubius*, 23 Mar 2014, idem (TFC Mic. 24519, 24523); idem, Santiago del Teide, La Gollada, 28°16'45"N, 16°48'05"W, 1045 m, *Euphorbia atropurpurea* scrub, on *Carlina salicifolia*, 13 Apr 2013, *LQ* & *al.* (TFC Mic. 24081); idem, Vilaflor, La Montañeta, 28°10'21"N, 16°38'49"W, 1790 m, typical Canary pine woodland, on *Sideritis soluta*, 9 Mar 2013, *LQ* & *CQ* (TFC Mic. 23928, 23929).

***Cyathicula hysteroioides*** (Rehm) E. Müll., Beitr. Kryptogamenfl. Schweiz 15(1): 35. 1977. – Fig. 5.

**Description** — Apothecia 0.9–1.5 mm in diam., 0.2–0.4 mm high, cupulate or discoid with narrow attachment, scattered to subgregarious, superficial, disc brown-grey (64.brGrey) to deep greyish brown (62.d.gyBr), usually less dark in middle, from light yellow (86.l.Y) or medium orange-yellow (71.m.OY), margin constituted by short whitish hairs; receptacle concolorous. Asci  $*(65-75-90(-98.3) \times (-5.7)7-7.8 \mu\text{m}$ ,  $\dagger(51.5-60.5-66.4(-69) \times (4.3-4.8-5.4(-6) \mu\text{m}$ ; cylindrical-clavate, 8-spored, 2-seriate, *pars sporifera*  $*30-33 \mu\text{m}$ , pore inamyloid; arising from simple septa. Ascospores  $*(10.6-13-14.3(-16.5) \times 2.5-3(-3.6) \mu\text{m}$ ,  $\dagger(9.4-11-12.3(-13.7) \times 1.8-2.6 \mu\text{m}$ ; subcylindric to fusiform, straight to inequilateral or slightly helicoid, aseptate, hyaline, thin-walled, without drops. Paraphyses cylindrical to slightly capitate, 3- or 4-septate; terminal cell  $*(20-23.7-29.3(-35.4) \times (2.5-3-3.5(-4.2) \mu\text{m}$ , basal cell  $*(10-14.7-18(-22) \times 2-3 \mu\text{m}$ ; simple, thin-walled, filled by tiny greyish yellow (90.gy.Y) drops (LBs, multiguttulate). Ectal excipulum at base to lower flank of *t. oblita*,  $*44-68 \mu\text{m}$  thick, at margin and upper flanks of *t. prismatica* to *t. porrecta*;  $*16-45 \mu\text{m}$  thick at margin and upper flank; deep yellow-brown (78.d.yBr) to deep greyish yellow (91.d.gy.Y); medullary excipulum differentiated in a non-gelatinized and hyaline *t. porrecta* to *t. intricata*, outermost layer of cells covered by amorphous resin-like matter or crystals. Ectal cells  $*(10.8-16-20.3(-30.5) \times (3-3.7-4.4(-6) \mu\text{m}$  at middle flank, wall thickness  $*0.4-1.6 \mu\text{m}$ ;  $*(10-13-16(-18.7) \times (3-3.4-4(-4.7) \mu\text{m}$  at margin. Protruding hyphae-like hairs at margin and upper flank with deep yellow-brown (75.deepyBr) to dark yellow-brown walls (78.d.yBr),  $*22-37 \times 3-4.3 \mu\text{m}$ ,

strongly encrusted with bright amorphous resin-like matter or crystals.

**Distribution and ecology** — In the N hemisphere in the Canary Islands (Tenerife), Europe (Austria, Germany, Iceland, Norway, Switzerland) and North America (United States). Growing on woody stems (*Aconitum*, *Arnica* L., *Gentiana* L., *Oxyria* Hill., *Todaroa*, *Xerophyllum* Michx.). Occurring from summer to autumn (Carpenter 1981; GBIF; Hansen & Knudsen 2000; Rehm 1882).

**Remarks** — *Cyathicula hysteroioides* is considered an alpine fungus, found at altitudes above 1600 m between summer and the beginning of autumn. In his monograph, Carpenter (1981) remarked on the inamyloid asci and large ascospores as being distinctive characters of this species. There are three similar alpine species: (1) *C. eschscholtziae* (Phillips & Harkn.) S. E. Carp. and (2) *C. nigrofusum* (Rehm) S. E. Carp., which differ in their shorter ascospores (7–12  $\mu\text{m}$  and 5–9  $\mu\text{m}$ , respectively); and (3) *C. fuscum* (Phillips & Harkn.) S. E. Carp., which differs in its 3-septate ascospores (Carpenter 1981). Our sample fits well with the ecology and the morphology presented by Carpenter (1981). This species is reported for first time in the Canary Islands.

**Specimen studied** — SPAIN: CANARY ISLANDS: TENERIFE: Arafo, Montaña Ismana, 28°22'22"N, 16°27'39"W, 1855 m, typical Canary pine woodland, remains of inflorescence of *Todaroa montana*, 20 Jun 2014, *LQ*, *RN* & *MR* (TFC Mic. 21122).

***Durella connivens*** (Fr.) Rehm, Ascomyceten 3: no. 18. 1881. – Fig. 6.

**Description** — Apothecia 0.2–0.4 mm in diam., to 0.3 mm high, turbinate to discoid, with narrow attachment, scattered to subgregarious, superficial, subsessile, dark greyish olive (111.d.gy.Ol) to olive-black (114.OlBlack). Asci  $*121.3-138.7(-142.3) \times 13.3-16.7 \mu\text{m}$ ,  $\dagger(71-75-89(-100.7) \times 8.7-10(-11) \mu\text{m}$ ; cylindrical-clavate, 8-spored, spores 2- or 3-seriate, *pars sporifera*  $*48-71.5 \mu\text{m}$ , pore inamyloid; arising from croziers. Ascospores  $*(29-32-36(-38.3) \times 4.2-5.2 \mu\text{m}$ ,  $\dagger24.3-34.4 \times 4.1-4.6 \mu\text{m}$ ; subcylindric to fusoid, straight to slightly curved, (5 or)6- or 7-septate, hyaline; thin-walled, filled by (3-)5–8 large greyish yellow (90.gy.Y) guttules (VB), when immature filled by many small guttules (multiguttulate), LCI = (20-)45–75(–90)%. Paraphyses uninflated cylindrical to medium clavate, multiseptate; terminal cell  $*(16-17-25.4(-29.6) \times 1.7-2.8 \mu\text{m}$ , basal cell  $*(8.2-11-19.7 \times 1.5-2.1 \mu\text{m}$ ; simple to bifurcate below second cell, thin-walled, with long greyish yellow (90.gy.Y) cylindrical VBs, slightly releasing a yellow pigment in KOH. Ectal excipulum from base to margin *t. oblita*, at base and lower flank  $*25-34 \mu\text{m}$  thick; at margin and upper flank  $*5.7-24.4 \mu\text{m}$ ; black (267.Black) to brown-

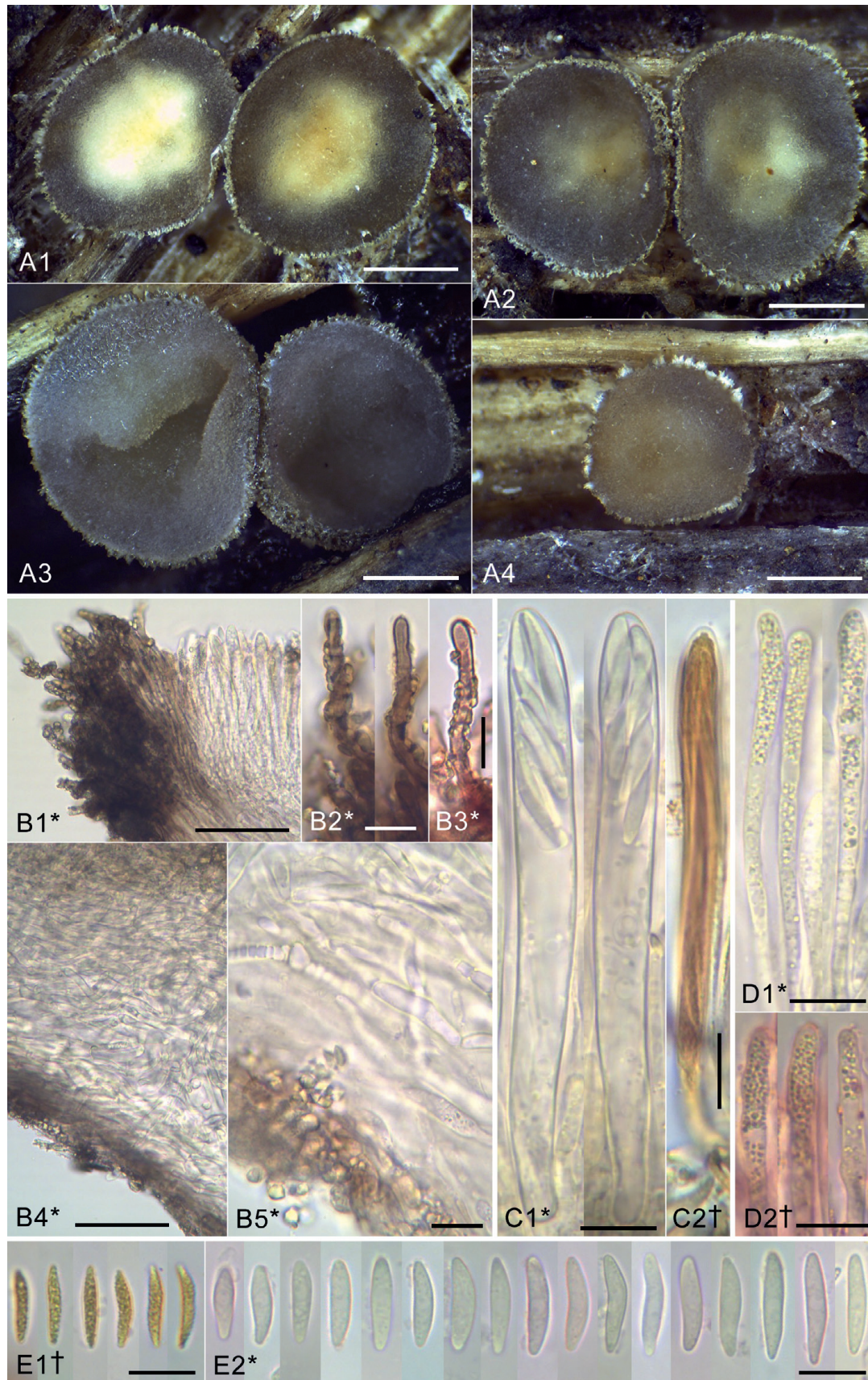


Fig. 5. Morphological features of *Cyathicula hysteroioides*. – A: apothecia; B: excipular tissues in section; C: asci; D: paraphyses; E: ascospores. – Scale bars: A1–4 = 500  $\mu$ m; B1 = 50  $\mu$ m; B2–5, C1, 2, D1, 2, E1, 2 = 10  $\mu$ m. – Mounted in: B3, D2 = CR; B1, 2, 4, 5, C1, D1, E2 = H<sub>2</sub>O; C2, E1 = MLZ. – All photos from TFC Mic. 21122.

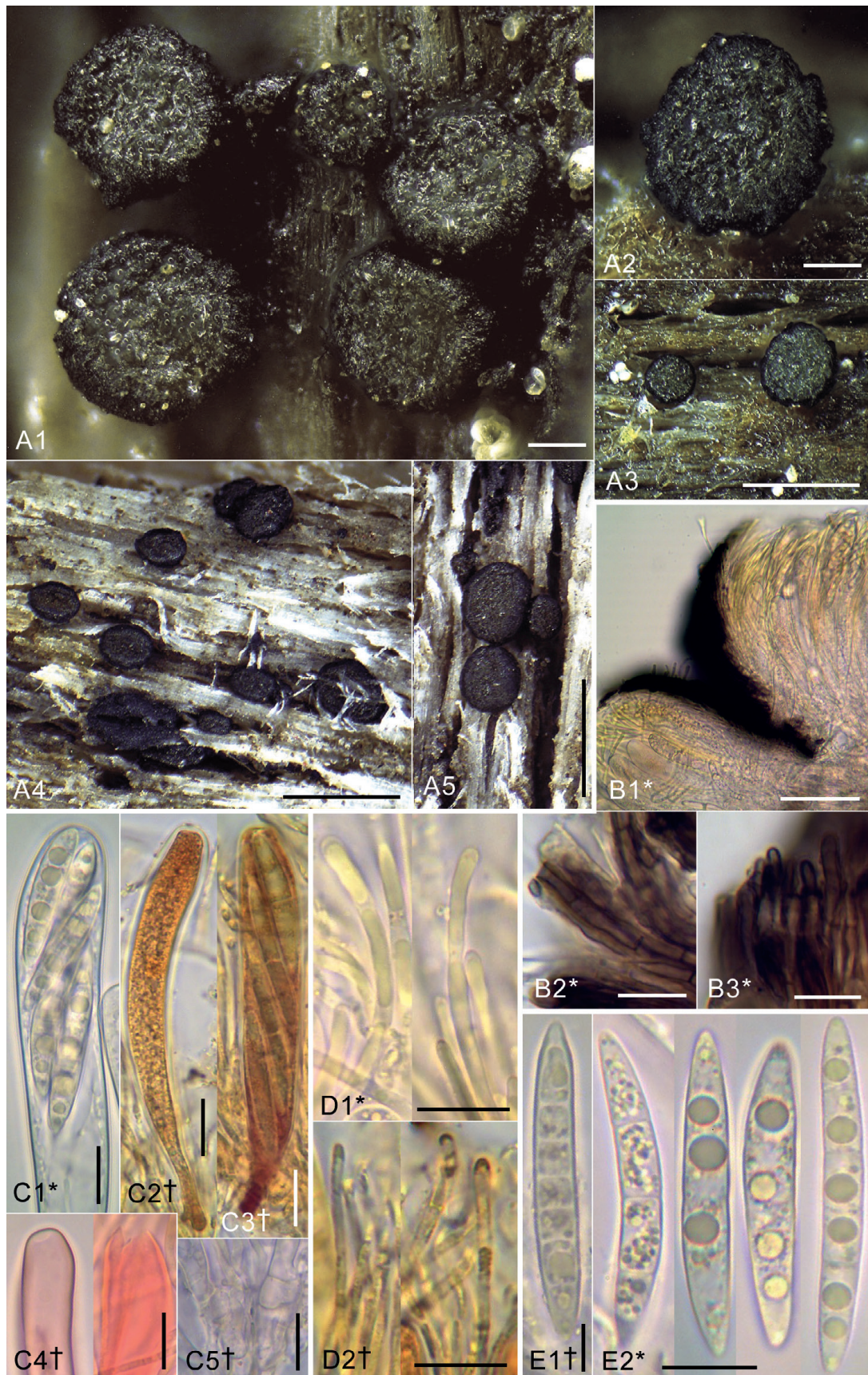


Fig. 6. Morphological features of *Durella connivens*. – A: apothecia; B: excipular tissues; C: asci; D: paraphyses; E: ascospores. – Scale bars: A3–5 = 500  $\mu$ m; A1, 2 = 100  $\mu$ m; B1 = 50  $\mu$ m; B2, 3, C1–5, D1, 2, E2 = 10  $\mu$ m; E1 = 5  $\mu$ m. – Mounted in: C4 = CR; B1–3, C1, 5, D1, E2 = H<sub>2</sub>O; E1 = KOH; C2, 3, D2 = MLZ. – All photos from TFC Mic. 24012.

black (65.brBlack), cell lumen light greyish red-brown (45.l.gy.rBr), cell wall dark red-brown (44.d.rBr), without crystals or exudates. Ectal cells  $*(7.8-8.5-11(-14) \times 1.8-2.8 \mu\text{m}$  at middle flank, wall thickness  $*0.3-0.9 \mu\text{m}$ ;  $*(8.3-10-12(-13.6) \times 1.8-3.2 \mu\text{m}$  at margin.

*Distribution and ecology* — In the N hemisphere in the Canary Islands (Tenerife), Europe (Austria, Denmark, Finland, France, Germany, Luxembourg, Spain, Sweden, United Kingdom), Asia (Israel, Japan) and North America (United States). In the S hemisphere in New Caledonia and New Zealand. Growing on hardwoods (*Betula*, *Chamaecytisus*, *Corylus*, *Crataegus*, *Fagus*, *Lonicera* L., *Malus*, *Phormium* J. R. Forst. & G. Forst, *Populus*, *Quercus*, *Ribes* L., *Salix*, *Spiraea*, *Ulex* L., *Ulmus*). Occurring in all seasons (Ascofrance 2015; Dennis 1956, 1986; GBIF; Hansen & Knudsen 2000).

*Remarks* — *Durella connivens* is differentiated from other species in the genus by its multiseptate ascospores and inamyloid asci. The Canarian specimen fits well with the descriptions in Dennis (1956). Some inamyloid species in the genus are differentiated as follows: *D. atrocyanea* (Fr.) Höhn has 3-septate ascospores and the apothecia are erumpent in decorticated wood; *D. commutata* Fuckel has 0- or 1-septate ascospores; *D. macrospora* Fuckel, *D. melanochlora* (Sommerf.) Rehm and *D. suecica* (Starbäck) Nannf. have shorter ascospores; other common species in the genus are amyloid (Baral & Marson 2005; Dennis 1956; Hansen & Knudsen 2000; Medardi 2004). In the last classification proposed by Baral (2016) for *Leotiomyces*, the genus was placed in the *Strossmayeria* Schulzer lineage. The genus *Durella* Tul. & C. Tul. is reported here for first time in the Canary Islands.

*Specimen studied* — SPAIN: CANARY ISLANDS: TENERIFE: La Orotava, Escobón Cortado, 28°19'51"N, 16°31'51"W, 1585 m, typical Canary pine woodland, on *Chamaecytisus proliferus*, 28 Mar 2013, LQ & CQ (TFC Mic. 24012).

*Pseudohelotium sordidulum* (P. Karst.) Huhtinen in Karstenia 34: 6. 1994. – Fig. 7.

*Description* — Apothecia 0.3–0.5 mm in diam., to 0.2 mm high, discoid with broad attachment, sparse, superficial, sessile, white (263.White) to yellow-white (92.yWhite), slightly hairy under margin. Hairs cylindrical, 2–4-septate, straight or undulating; slightly thickened glassy walls (to 0.8  $\mu\text{m}$ ), surface smooth, aguttulate, without resinous matter or changes in CR, KOH, LUG or MLZ; at upper flank  $*20-49.6 \times 2.5-2.7 \mu\text{m}$  at base, at margin  $*11-15 \times 3-3.8 \mu\text{m}$ . Asci  $*93-103(-107) \times 8-10(-11) \mu\text{m}$ ,  $\dagger 72-79.5(-84) \times 6-7.4 \mu\text{m}$ ; cylindrical-clavate, 8-spored, 2–4-seriate, *pars sporifera*  $*31.5-41 \mu\text{m}$ , IKI+; arising from croziers. Ascospores  $*(17.8-20-22(-26.6) \times 2.5-3.3 \mu\text{m}$ ,  $\dagger 15.6-20 \times$

$2.2-2.8 \mu\text{m}$ ; fusiform to clavate-subulate, inequilateral, straight to medium curvate, 1–3(or 4)-septate, hyaline, thin-walled, multiguttulate, LCI =  $(7-12-20(-30) \%$ . Paraphyses uninflated cylindrical to slightly clavate, 3- or 4-septate; terminal cell  $*(15.6-17-20.6(-23) \times 1.7-2.6(-3.5) \mu\text{m}$ , basal cell  $*(8.6-11-14.5 \times 1.4-1.7 \mu\text{m}$ ; simple to bifurcated near apex, thin-walled, apparently aguttulate, but with minute SCBs in apical cell. Ectal excipulum from base to margin of *t. angular* to *t. prismatica*,  $*34-79 \mu\text{m}$  thick at base and middle flanks;  $*7-35 \mu\text{m}$  thick at margin and upper flank; hyaline to light brown (57.l.Br), slightly gelatinized at upper flank and margin, without crystals or resinous matter. Ectal cells  $*(9-10.5-13(-14) \times (5.4-6.3-8.2 \mu\text{m}$  at middle flank, wall thickness  $*0.3-0.8 \mu\text{m}$ ;  $*(8-9-12.3(-15.3) \times 3-6 \mu\text{m}$  at margin.

*Distribution and ecology* — In the N hemisphere in the Canary Islands (Tenerife) and Europe (Czech Republic, Denmark, Finland, Germany, Luxembourg, Spain). Growing on softwood and cone scales of *Pinus*. Occurring in all seasons (Ascofrance 2015; GBIF; Huhtinen 1994; Karsten 1869; Marson & al. 1996; Svrček 1987).

*Remarks* — Huhtinen (1994) conducted a historical survey of this species, explaining the differences observed by different authors since Karsten (1869) described *Peziza sordidula* P. Karst. (the basionym) as follows: apothecia gregarious, pale, without margin, 0.2–0.3 mm in diam.; ascospores fusoid to acicular, straight or curvate,  $(14-18-25(-30) \times 3-4 \mu\text{m}$ , with drops; asci cylindrical-clavate,  $65-75 \times 9-11 \mu\text{m}$ , pore amyloid; and paraphyses cylindrical, to 1  $\mu\text{m}$  at apex; growing on wood of *Pinus sylvestris* (Karsten 1869). More than 100 years later, Svrček (1987) gave a detailed description of a new combination in the genus *Pseudohelotium* Fuckel, *P. vernale* (Vel.) Svrček, nowadays considered a synonym of *P. sordidulum*. In his description, Svrček described the excipulum, obtaining slightly different ascospore measurements  $(17-19.5 \times 2.5-3 \mu\text{m})$  and explained that the marginal hyphae grow out and have thick walls. The morphology and ecology agree with references of this species (Huhtinen 1994; Karsten 1869; Svrček 1987). The genus is currently placed as incertae sedis in the order *Helotiales* (Baral 2016) and none of its species has been studied by molecular methods. The genus *Pseudohelotium* is reported here for the first time in the Canary Islands.

*Pseudohelotium pineti* (Batsch) Fuckel is the most similar species, but in that species the excipulum is brownish, the protruding hyphae in the excipulum are clavate, without thickened walls, the asci are shorter (to 70  $\mu\text{m}$  long) and the ascospores are narrower (to 2  $\mu\text{m}$  wide) (Dennis 1956, 1978).

*Specimen studied* — SPAIN: CANARY ISLANDS: TENERIFE: La Orotava, Teide National Park, Los Lajones, 28°19'51"N, 16°29'37"W, 2060 m, Canary pine wood-

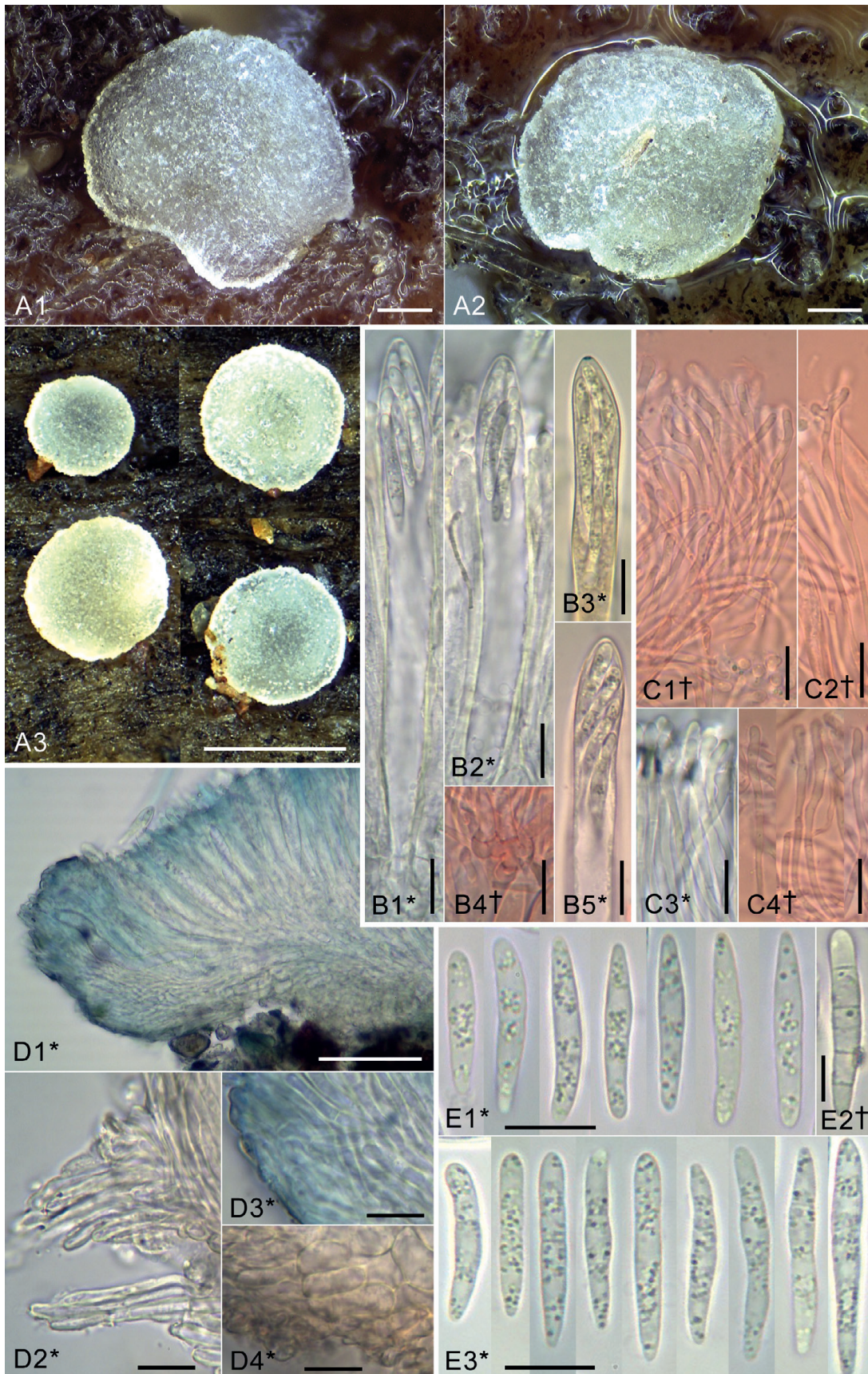


Fig. 7. Morphological features of *Pseudohelotium sordidulum*. – A: apothecia; B: asci; C: paraphyses; D: excipular tissues in section and hairs; E: ascospores. – Scale bars: A3 = 500  $\mu$ m; A1, 2 = 100  $\mu$ m; D1 = 50  $\mu$ m; B1–5, C1–4, D2–4, E1, 3 = 10  $\mu$ m; E2 = 5  $\mu$ m. – Mounted in: D1, 3 = CRB; B4, 5, C1, 2, 4 = CR; B1, 2, C3, D2, 4, E1–3 =  $H_2O$ ; B3 = LUG. – All photos from TFC Mic. 23870.

land with summit brooms, on *Pinus pinaster*, 21 Feb 2013, *LQ* & *CQ* (TFC Mic. 23870).

*Strossmayeria basitricha* (Sacc.) Dennis, Brit. Cup Fungi & Allies: 73. 1960. – Fig. 8.

**Description** — Apothecia (0.3–)0.4–0.5(–0.7) mm in diam., to 0.4 mm high, pulvinate, scattered to gregarious, superficial, sessile, usually deep greyish yellow (91.d.gy.Y) to medium olive-brown (95.m.OlBr), occasionally blue-grey (191.b.Grey). Asci \*(133.7–)154–181.5(–219) × (14–)15–16(–17.6)  $\mu\text{m}$ , †(112–)127.4–143(–164.8) × (–9.3)12.4–14(–16)  $\mu\text{m}$ ; cylindric-clavate, 8-spored, spores 2- or 3-seriate, *pars sporifera* \*66–102  $\mu\text{m}$ , IKI+; arising from croziers. Ascospores \*(27.7–)35–39(–43.6) × 4.4–5.5(–7.2)  $\mu\text{m}$ , †(25–)31–35(–37.6) × 3.6–4.7  $\mu\text{m}$ ; cylindric to subcylindric, straight to slightly curved (helicoid), (5 or)6- or 7-septate, hyaline; with a wrinkled gelatinous thick wall, 0.8–1.9  $\mu\text{m}$  wide, filled by small guttules surrounded by (1 or)2 or 3(–6) large guttules, LCI = (12–)45–75(–90)%. Paraphyses uninflated cylindric to medium clavate, multiseptate; terminal cell \*(38.4–)44.5–58.5(–65) × 2.7–4.4  $\mu\text{m}$ , basal cell \*(16–)19–30(–39) × 2–4  $\mu\text{m}$ ; simple to bifurcate below second cell, thin-walled, with greyish yellow (90.gy.Y) cylindric VBs releasing a yellow pigment in KOH. Ectal excipulum from base to margin of *t. porrecta* to *t. prismatica*, at base and lower flank \*41–115  $\mu\text{m}$  thick; at margin and upper flank \*11–34  $\mu\text{m}$ ; hyaline at margin to medium brown (58.m.Br) or deep brown (59.d.Br) near base, without crystals or exudates. Ectal cells \*(9.5–)13.7–16.3(–22.7) × (3.7–)4.7–5.7  $\mu\text{m}$  at middle flank, wall thickness \*0.1–0.8  $\mu\text{m}$ ; \*(6–)9–12(–15) × 2.4–4.4  $\mu\text{m}$  at margin.

**Distribution and ecology** — In the N hemisphere in the Canary Islands (Gomera, La Palma, Tenerife), Azores (Terceira), Europe (Austria, Belgium, Czech Republic, Denmark, France, Germany, Italy, Norway, Slovakia, Spain, Switzerland, United Kingdom), Asia (Japan) and North America (Mexico, United States). In the S hemisphere in New Zealand. Growing on hardwoods (*Acer*, *Carpinus*, *Castanea*, *Chamaecytisus*, *Corylus*, *Fagus*, *Fraxinus*, *Ilex* L., *Laurus*, *Morella*, *Picconia*, *Platanus* L., *Prunus*, *Quercus*, *Rubus*). Occurring in all seasons, more abundantly from summer to autumn (Ascofrance 2015; Dennis 1978, 1986; GBIF; Iglesias & al. 2013; Iturriaga & Korf 1990; Karasch & al. 2005).

**Remarks** — *Strossmayeria basitricha* is differentiated from other species in the genus by its light-coloured apothecia (pale brown to grey), clavate asci and the following ascospore characteristics: (1) hyaline wall; (2) gel sheath verrucose and narrower than 1.5  $\mu\text{m}$ ; (3) 5–7-septate ascospores; and (4) measurements. Two species are very similar: Iturriaga & Korf (1990) distinguished *S. bakeriana* (Henn.) Iturr. because its as-

cospores have a longer range of variation (26–48  $\mu\text{m}$  vs 30–64  $\mu\text{m}$ ); while *S. alba* (P. Crouan & H. Crouan) Iturr. & Korf is differentiated by its shorter asci (82–140  $\mu\text{m}$  vs 82–114  $\mu\text{m}$ ) and fewer septa in the conidia (5–11 vs 6–8). In the current classification of *Leotiomycetes*, the genus is placed in the *Strossmayeria* lineage (Hustad & Miller 2011; Baral 2016).

Using the key for the genus in Iturriaga & Korf (1990), the European collections of the genus are difficult to identify, as is manifested in discussions in Ascofrance forums. The morphological and biometrical characters exposed among *S. alba*, *S. bakeriana* and *S. basitricha*, and also with other species, overlap in the majority of cases.

**Specimens studied** — SPAIN: CANARY ISLANDS: TENERIFE: Santa Cruz de Tenerife, Anaga Rural Park, Barranco la Mina, 28°33'12"N, 16°11'05"W, 780 m, hygrophilous evergreen laurel forest, on *Morella faya*, 14 Feb 2012, *LQ* & *CQ* (TFC Mic. 23378); idem, 24 Oct 2012, idem (TFC Mic. 23695), idem, on *Laurus novocanariensis*, 14 Feb 2012, idem (TFC Mic. 23686); idem, Descansaderos de Tierra, 28°32'21"N, 16°13'25"W, 860 m, *Erica platycodon* ridge-crest evergreen forest, on *Morella faya*, 7 Apr 2013, idem (TFC Mic. 24062); idem, Cabezo de la Mina, 28°33'20"N, 16°11'02"W, 800 m, idem, 28 May 2012, idem (TFC Mic. 23508); idem, on *Laurus novocanariensis*, 19 Oct 2013, idem (TFC Mic. 24328, 24331); idem, Rosa Alta, 28°33'11"N, 16°11'16"W, 765 m, hygrophilous evergreen laurel forest, on *Prunus lusitanica* subsp. *hixa*, 24 Oct 2013, idem (TFC Mic. 23698); idem, on *Ilex canariensis*, 13 Aug 2013, idem (TFC Mic. 24279); idem, El Pijaral, 28°33'11"N, 16°11'18"W, 775 m, humid evergreen laurel forest, idem, 19 Feb 2011, *LQ* & *al.* (TFC Mic. 23120); idem, on *Laurus novocanariensis*, idem (TFC Mic. 23120); idem, on *Ilex canariensis*, 13 Aug 2013, *LQ* & *CQ* (TFC Mic. 24256); idem, Tegueste, Anaga Rural Park, Hoya Zapata, 28°31'51"N, 16°17'46"W, 820 m, idem, on *Laurus novocanariensis*, 8 May 2013, idem (TFC Mic. 24192); idem, Hoya el Palomo, 28°32'03"N, 16°19'37"W, 640 m, dry evergreen laurel forest, on *Ilex canariensis*, 16 Jun 2012, idem (TFC Mic. 23529); idem, on *Picconia excelsa*, 16 Jun 2012, idem (TFC Mic. 23539); idem, on *Laurus novocanariensis*, idem (TFC Mic. 23541, 23543).

*Velutarina rufolivacea* (Alb. & Schwein.) Korf in Phytologia 21: 201. 1971. – Fig. 9.

**Description** — Apothecia 1–1.8 mm in diam., to 1 mm high, scattered to subgregarious, superficial, sessile, disc light olive-green (94.l.OlBr) to light olive (106.l.Ol), flat to slightly depressed at maturity, margin recurvate, receptacle cottony and pink-grey (10.pkGrey). Asci \*(166.6)173.4–212(–223) × 14.4–16.4  $\mu\text{m}$ , †119.4–141.4 × 8.3–13.4  $\mu\text{m}$ ; cylindric-clavate, 8-spored, \*1-seriate, *pars sporifera* \*85–106  $\mu\text{m}$ , apex round with an api-



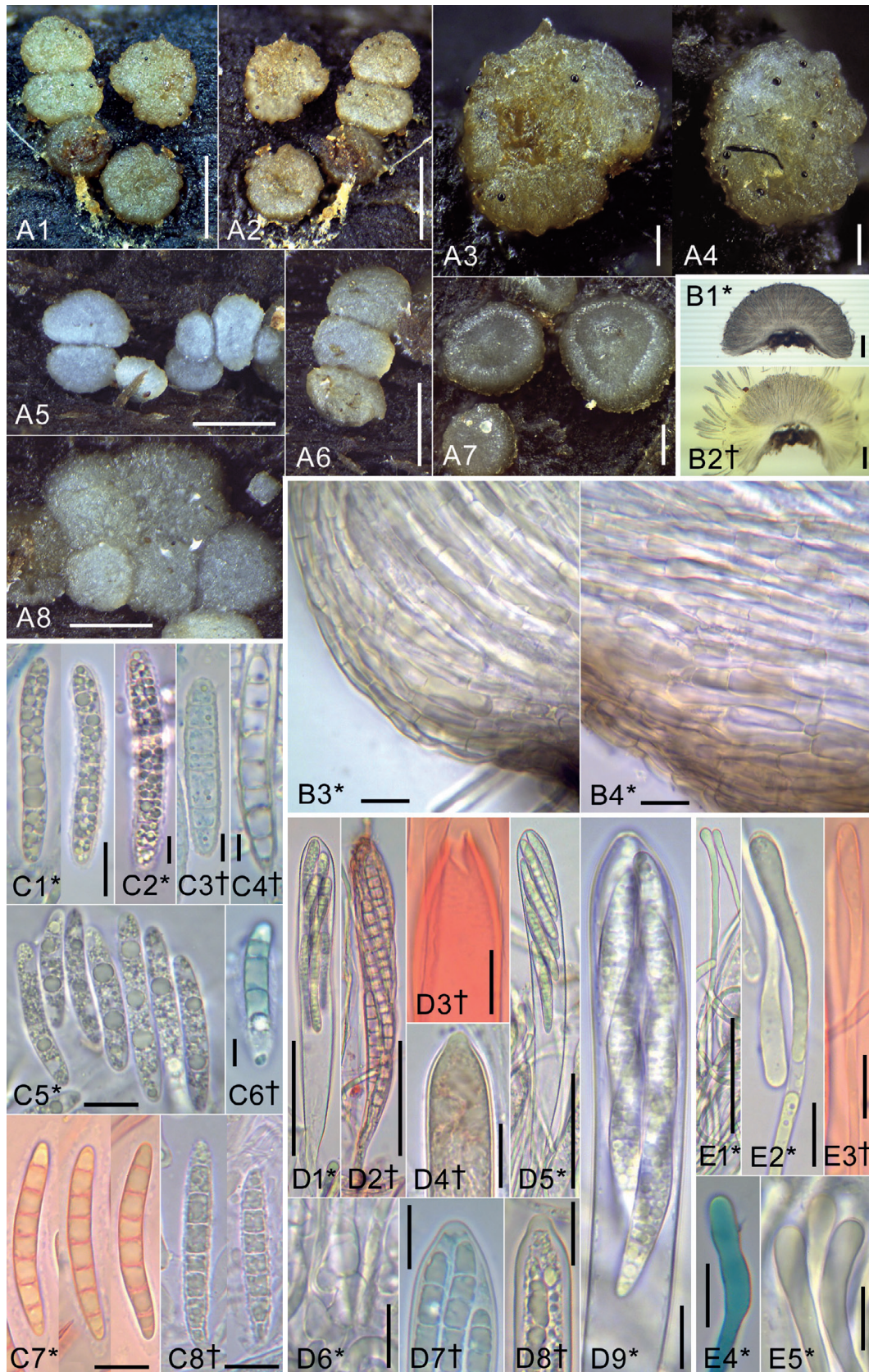


Fig. 8. Morphological features of *Strossmayeria basitricha*. – A: apothecia; B: excipular tissues; C: ascospores; D: asci; E: paraphyses. – Scale bars: A1, 2, 5, 6, 8 = 500  $\mu\text{m}$ ; A3, 4, 7, B1, 2 = 100  $\mu\text{m}$ ; D1, 2, 5, E1 = 50  $\mu\text{m}$ ; B3, 4, C1, 5, 7, 8, D3, 4, 6–9, E2–5 = 10  $\mu\text{m}$ ; C2–4, 6 = 5  $\mu\text{m}$ . – Mounted in: C3, 6, D7, E4 = CRB; C2, 7, D2, 3, E3 = CR; B1, 3, 4, C1, 4, 5, 8, D1, 5, 6, 8, 9, E1, 2, 5 =  $\text{H}_2\text{O}$ ; B2 = KOH; D4 = MLZ. – Photos from: A1–4, B4, C1–4, D1, 2, 6–8, E4 = TFC Mic. 23378; A7, C5, 6 = TFC Mic. 23508; B3, D9 = TFC Mic. 24062; E5 = TFC Mic. 24192; A5, 6, 8, B1, 2, C7, 8, D3–5, E1–3 = TFC Mic. 24279.

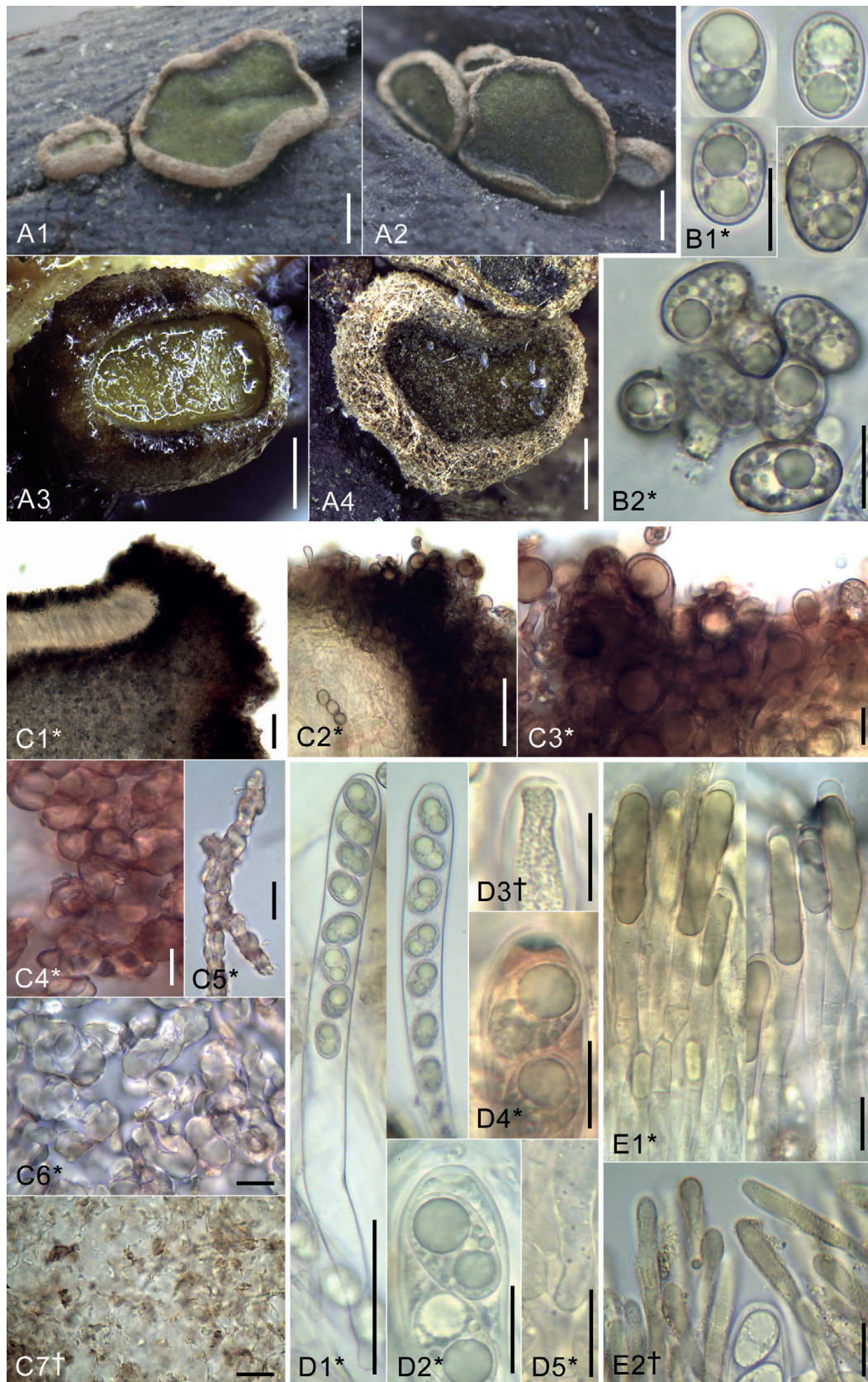


Fig. 9. Morphological features of *Velutaria rufolivacea*. – A: apothecia; B: ascospores; C: excipular tissues; C1: section; C2, 3: ectal cells at margin; C4: ectal cortical cells at lower flank; C5: protruding cells at flank; C6, 7: ectal cells at inner layer; D: asci; D1: living asci; D2–4: ascus apex; D5: ascus base; E: living and dead paraphyses. – Scale bars: A1–4 = 500  $\mu$ m; C1 = 100  $\mu$ m; C2, D1 = 50  $\mu$ m; B1, 2, C3–7, D2–5, E1, 2 = 10  $\mu$ m. – Mounted in: C3–5 = CR; B1, 2, C1, 2, 6, D1, 2, 5, E1 = H<sub>2</sub>O; C7, D3, E2 = KOH; D4 = LUG. – All photos from TFC Mic. 23496.

cal thickening  $\dagger 0.9\text{--}2.4\ \mu\text{m}$ , pore dextrinoid in LUG, IKI+ (hemiamyloid reaction); asci arising from simple septa. Ascospores  $*12.3\text{--}13.7 \times 7.7\text{--}9.5\ \mu\text{m}$ ,  $\dagger 10.7\text{--}13 \times 6\text{--}8\ \mu\text{m}$ ; ellipsoid to rarely obovoid, straight, aseptate, hyaline (brownish in overmature spores), thin-walled, completely filled by lipid bodies, 1 or 2 guttules larger than others,  $*3.7\text{--}5.2\ \mu\text{m}$  in diam. (LCI = 45–90%), when dead usually appearing as one large, globose to elongate guttule. Paraphyses slightly to medium clavate, sometimes sublageniform, straight to slightly sinuous; terminal cell  $*(29\text{--})33\text{--}43(-48.7) \times (4.5\text{--})5.5\text{--}7.3(-8.5)\ \mu\text{m}$ , basal cell  $*19.5\text{--}23.4 \times 2.1\text{--}2.5\ \mu\text{m}$ ; branched near apex, usually bifurcate, thin-walled, living apical cell filled by a large light olive-brown (94.1.OlBr) vacuolar body  $*11\text{--}28 \times 4\text{--}7\ \mu\text{m}$ . Ectal excipulum not clearly delimited from medullar layer, of *t. intricata* mixed with globose cells, cortical layer of *t. angular* to *t. globulosa*,  $*194\text{--}700\ \mu\text{m}$  thick from base to upper flanks, light brown (57.1.Br) to dark brown (59.d.Br), strongly gelatinized (losing it after adding KOH), with refractive appearance due to glassy walls of cells. Prismatic cells at base and flanks in inner layer  $*8.5\text{--}21 \times 2.3\text{--}4.3\ \mu\text{m}$ , with glassy refractive wall  $*1.9\text{--}5\ \mu\text{m}$  thick, cortical cells at base and flanks globose to clavate  $*13.4\text{--}17.7 \times 7.9\text{--}10.4\ \mu\text{m}$ , with a large light olive-brown (94.1.OlBr) vacuolar body, usually with outermost cells forming irregular protrusions of prismatic cells (1–7 cells) similar to hairs. Margin of *t. globulosa*  $*56\text{--}153\ \mu\text{m}$  thick, outermost cells clavate,  $*12.4\text{--}21.5 \times 7\text{--}14\ \mu\text{m}$ , filled by a light olive-brown (94.1.OlBr) refractive globose vacuolar body.

**Distribution and ecology** — In the N hemisphere in the Canary Islands (Gomera, Tenerife), Europe (Austria, Czech Republic, Denmark, France, Finland, Germany, Netherlands, Norway, Sweden, United Kingdom), Asia (China, Pakistan) and North America (Canada). In the S hemisphere in New Zealand. Growing on hardwoods (*Acer*, *Andromeda* L., *Arbutus* L., *Berberis* L., *Betula*, *Corylus*, *Crataegus*, *Cytisus* L., *Fagus*, *Fraxinus*, *Liquidambar* L., *Malus*, *Morella*, *Quercus*, *Rhododendron* L., *Rosa* L., *Rubus*, *Salix*, *Sassafras* J. Presl, *Tilia*, *Ulex*, *Viburnum* L., *Vitis* L.), on softwood (*Juniperus* L., *Picea*) and on fern rachises (*Pteridium*). Occurring in all seasons (Dennis 1956, 1978, 1986; GBIF; Kummer 2002; Van-Vooren 2009; Zhuang 1999).

**Remarks** — There are four accepted species in the genus. *Velutarina rufolivacea* and *V. juniperi* (Dennis) K. Holm & L. Holm (Kirk & al. 2008) differ in the colour of their apothecia: greenish in *V. rufolivacea* vs yellow in *V. juniperi*; and their asci: amyloid in *V. rufolivacea* vs inamyloid in *V. juniperi* (Hansen & Knudsen 2000). A third species, *V. phaeosporum* (Cooke) Korf, appeared as an unclear taxon in Kirk & al. (2008), but it was synonymized in Dennis (1956) with *V. rufolivacea*. Two new species were published three years ago (Baral & Perić 2014): *V. bertiscensis* B. Perić & Baral has larger ascospores than

*V. rufolivacea* and *V. juniperi*, while *V. alpestris* B. Perić & Baral has narrower spores. All the characteristics of our sample fit well with the descriptions of *V. rufolivacea* consulted (Baral & Marson 2005; Dennis 1956, 1978; Hansen & Knudsen 2000; Baral & Perić 2014). In the last classification proposed by Baral (2016) for *Leotiomyces*, the genus was placed in the *Cenangiaceae* lineage, well supported in a recent multi-locus phylogeny (Pärtel & al. 2017). The genus *Velutarina* Korf is reported here for first time in the Canary Islands.

**Specimens studied** — SPAIN: CANARY ISLANDS: TENERIFE: Los Silos, Teno Rural Park, Lomo Alto,  $28^{\circ}20'04''\text{N}$ ,  $16^{\circ}49'22''\text{W}$ , 750 m, dry evergreen laurel forest, on *Arbutus canariensis*, 4 May 2012, LQ & al. (TFC Mic. 23496). — GOMERA: Valle Gran Rey, Garajonay National Park, Apartacaminos,  $28^{\circ}08'08''\text{N}$ ,  $17^{\circ}16'51''\text{W}$ , 1100 m, humid evergreen laurel forest, on *Morella faya*, 20 Mar 2016, RN (RN-16032001).

## Discussion

Our study of the *Helotiales* in the Canary Islands has corrected a previous record of species occurrence (*Asco-coryne cylichnium*), added new information on *Cyathicula* (a new report of *C. hysterooides*) and has reported three new genera (*Durella*, *Pseudohelotium*, *Velutarina*), each with one species.

*Asco-coryne cylichnium* and *A. sarcoides* are common in the N hemisphere on hardwood and softwood and appear throughout the year. In the Canary Islands the occurrence of fruit bodies is similar, but both species seem to be restricted to the laurel forest on hardwood. The morphological characteristics of our *A. cylichnium* samples fit well with the consulted references (Dennis 1956; Gamundí & Romero 1998; Hansen & Knudsen 2000; Roll-Hansen & Roll-Hansen 1979), although it is important to remark that the ascospore length in the Canarian samples is in the lower part of the range of variation [ $*(14\text{--})16\text{--}17.5(-18.5)\ \mu\text{m}$ ], something that should be studied using molecular tools and more samples to elucidate if the Canarian specimens could belong to a different species. *Chlorociboria aeruginascens* is one of the most frequently reported species of lignicolous *Helotiales* in the Canary Islands and its ecology coincides with the general knowledge reported before for this taxon (Johnston & Park 2005). *Cyathicula cyathoidea* has a wide ecological spectrum: a worldwide distribution, on all types of substrates (hardwood, softwood, herbaceous stems, woody stems, rachises of ferns, dead culms and leaves) and occurs in all seasons. In the Canary Islands it grows at altitudes of 500–2200 m in all types of vegetation (*Euphorbia* scrub, pine forest, laurel forest, summit-broom scrub) and on hardwood, softwood, woody and herbaceous stems (Beltrán-Tejera & al. 2004, 2008), so it has the same wide range there. On the other hand, *C.*

*hysterioides* has only been found once in dry pine forest on an endemic *Apiaceae*, but the substrate fits very well with the bibliography (Carpenter 1981; Hansen & Knudsen 2000; Rehm 1882). The Canarian reports of *Durella connivens* and *Pseudohelotium sordidulum* are the southernmost records of these taxa in the N hemisphere; moreover the latter and *C. cyathoidea* are the only two species of *Helotiales* in the summit-broom scrub in the highest altitudes of the archipelago. *Strossmayeria basitricha* is a common species distributed only on hardwoods in the laurel forest, while *Velutarina rufoolivacea* has been found for first time in dry laurel forest on the endemic *Arbutus canariensis*, although this species has been reported previously on other species of the genus *Arbutus*.

The diversity of lignicolous *Helotiales* is mainly distributed in the laurel or pine forest between 350–2000 m in altitude. There is only one species in *Euphorbia* scrub (*Cyathicula cyathoidea*), and it is at the same time the most ecologically widespread in the Canary Islands, reaching the highest altitude in the archipelago, above 2000 m in the summit-broom scrub, where only one other species has been found (*Pseudohelotium sordidulum*).

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