Contribution to the smut fungi of Greece

Authors: Denchev, Teodor T., and Denchev, Cvetomir M.

Source: Willdenowia, 46(2) : 233-244

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: https://doi.org/10.3372/wi.46.46204

Willdenowia
Annals of the Botanic Garden and Botanical Museum Berlin-Dahlem

TEODOR T. DENCHEV[1] & CVETOMIR M. DENCHEV[1]*

Contribution to the smut fungi of Greece

Version of record first published online on 28 July 2016 ahead of inclusion in August 2016 issue.

Abstract: After examination of specimens in the herbarium of the Botanic Garden and Botanical Museum Berlin, eight species of smut fungi are reported for the first time from Greece: *Microbotryum dianthorum* on *Dianthus viscidus*, *Sporisorium pulverulentum* on *Saccharum strictum*, *Tilletia fusca* on *Vulpia ciliata*, *T. lolii* on *Lolium temulentum*, *Urocystis dactylidina* on *Dactylis glomerata* subsp. *hackelii*, *U. johansonii* on *Juncus bufonius*, *U. ornithogali* on *Ornithogalum* sp. and *U. ulei* on *Festuca jeanpertii*. Four species of smut fungi are recorded on new host plants making new fungus-host combinations: *Microbotryum dianthorum* on *Dianthus viscidus*, *Tranzscheliella williamsii* on *Stipa isoldeae*, *Urocystis dactylidina* on *Dactylis glomerata* subsp. *hackelii* and *U. ulei* on *Festuca jeanpertii.* Two plant species are reported as new hosts of smut fungi already known from Greece: *Stipa isoldeae* for *Tranzscheliella williamsii*, and *Lygeum spartum* for *T. hypodytes*. All ten species of smut fungi are illustrated. A description is also provided for *Urocystis agropyri*, recorded in Greece on *Thinopyrum junceum*.

Key words: *Dactylis glomerata* subsp. *hackelii*, *Dianthus viscidus*, *Festuca jeanpertii*, Greece, *Microbotryum*, smut fungi, *Sporisorium*, taxonomy, *Stipa isoldeae*, *Tilletia*, *Tranzscheliella*, *Urocystis*

Article history: Received 4 January 2016; peer-review completed 7 April 2016; received in revised form and accepted for publication 22 April 2016.

Citation: Denchev T. T. & Denchev C. M. 2016: Contribution to the smut fungi of Greece. – Willdenowia 46: 233–244. doi: http://dx.doi.org/10.3372/wi.46.46204

Introduction

Greece is home to an unusually high diversity of vascular plants, ranking among the highest in Europe and the Mediterranean area with 5752 species, and one of the most important centres of endemism with 1278 endemic species (22.2 % of the total number of species) (Dimopoulos & al. 2013). This is a prerequisite for a high species richness of parasitic fungi on plants. However, the diversity of the smut fungi in Greece (*Ustilaginomycotina* and *Microbotryales*) is not intensively studied. No regional monographic study has been carried out yet. To date, only 66 species on 77 vascular plant species have been reported, making 86 smut-host combinations (Hohenbühel 1868; Bornmüller 1894, 1928; Magnus 1894; Maire 1905, 1917; Sarejanni 1935, 1939; Sydow 1935; Săvulescu 1937; Konstantinia-Sulidu 1939; Maire & Politis 1940; Petrak 1943, 1944, 1956; Apostolides 1952; Critopoulos 1953; Demetriades & Zachos 1962; Durrieu 1968; Brandenburger 1969; Pyrowolakis & Weltzien 1970; Vánky 1980, 1985b, 1986, 1989, 1990a, b, 1991, 1992, 1996, 1998, 2003a, b, 2008, 2011; Scholz & Scholz 1988; Scheuer 1992, 2010; Vánky & Oberwinkler 1994; Denchev 1997; Triebel 1998, 1999; Vánky & Scholz 2001; Vánky & Berner 2003; Kashefi & Vánky 2004; Vánky & al. 2005; Denchev & Minter 2008, 2011a, b; Braun 2013; Denchev & al. 2013; Savchenko & al. 2014).

In the present article, eight species of smut fungi (indicated by * in the text) are reported for the first time from Greece: *Microbotryum dianthorum*, *Sporisorium pulverulentum*, *Tilletia fusca*, *T. lolii*, *Urocystis dactylidina*, *U. johansonii*, *U. ornithogali* and *U. ulei*. Four fungus-host combinations are recorded for the first time: *Microbotryum dianthorum* on *Dianthus viscidus*, *Tranzscheliella williamsii* on *Stipa isoldeae*, *Urocystis dactylidina* on *Dactylis glomerata* subsp. *hackelii* and *Urocystis ulei* on *Festuca jeanpertii*. Two plant species are reported as new hosts of smut fungi already known from Greece: *Stipa*

1 Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 2 Gagarin St., 1113 Sofia, Bulgaria; e-mail: ttdenchev@gmail.com; *cmdenchev@yahoo.co.uk (author for correspondence).

isoldeae for *Tranzscheliella williamsii* and *Lygeum spartum* for *T. hypodytes.*

The smut fungi reported here were found during examination of specimens in the herbarium of the Botanic Garden and Botanical Museum Berlin.

Material and methods

Dried specimens from the herbarium of B (herbarium code according to Thiers 2016+) were examined under a light microscope (LM) and a scanning electron microscope (SEM). For LM observations and measurements, spores were mounted in lactoglycerol solution (w : la : gl = 1 : 1 : 2) on glass slides, gently heated to boiling point to rehydrate the spores, and then cooled. The measurements of spores are given as min-max (mean ± 1 standard deviation). For SEM, spores were attached to specimen holders by double-sided adhesive tape and coated with platinum-palladium in an ion sputter. The surface structure of the spores was observed and photographed at 5 kV accelerating voltage using a JEOL JSM-7600F scanning electron microscope (Naturalis Biodiversity Center, Leiden, The Netherlands). The descriptions below are based entirely on the specimens examined. The description of spore ornamentation is in accordance with Denchev & al. (2013). The height of the wall ornamentation (warts and spines) was measured with SEM. Lists of shapes of sterile cells or spores are arranged in decsending order of frequency.

New records of smut fungi for Greece

Microbotryum dianthorum (Liro) H. Scholz & I. Scholz in Englera 8: 206. 1988, s. lat. – Fig. 1A–C.

Sori in anthers (some flowers may be unaffected). Spore mass dark reddish brown. *Spores* globose, subglobose, broadly ellipsoidal, ellipsoidal or ovoid, (5.5–)6–8.5(–9.5) × (5–)5.5–7.5(–8) (7.2 ± 0.6 × 6.4 ± 0.5) µm (*n* = 100), pale vinaceous; spore wall reticulate, 1–1.5 µm thick; meshes (5–)6–9 per spore diameter, polygonal or rounded, 0.4–1(–1.8) µm wide; muri 0.5–0.9 µm high; interspaces in SEM smooth or rugulose.

Specimen examined — On *Dianthus viscidus* Bory & Chaub. – Greece: Sterea Ellas, Prov. Etolia Akarnania, Panatolikos massif, 1450–1550 m, 30 Jun 1982, *H. Scholz* (B 70 0007639).

Note — Dianthus viscidus is a new host for *Microbotryum dianthorum.*

Sporisorium pulverulentum (Cooke & Massee) Vánky in Symb. Bot. Upsal. 24(2): 120. 1985. – Fig. 1D–F.

Sori in all spikelets of inflorescence, elongate to cylindric, c. 1.5 × 0.7 mm, partially concealed by glumes, covered by a thick yellow-brown to rusty brown peridium that ruptures irregularly (usually at apex) exposing a single, stout, tapering, sometimes slightly branched columella with shallow, longitudinal furrows. Columella to 5 mm long, surrounded by powdery, blackish brown mass of spores and sterile cells. *Sterile cells* in irregular groups (single sterile cells not seen), subglobose, broadly ellipsoidal or irregular, often collapsed, (7–)8.5–16.5(–18.5) µm long, hyaline; cell wall 0.6–1.2 µm thick, smooth. *Spores* subglobose, broadly ellipsoidal, slightly irregular or ovoid, sometimes ellipsoidal, (9.5–)10–13.5(–15) × (8.5–)9.5–12(–13) (12.0 ± 0.8 × 10.8 ± 0.8) µm (*n* = 100), medium yellow-brown; spore wall ± evenly thickened, 0.6–0.8(–1) µm thick, often with one or two paler, rounded areas of 2.5–4 µm in diam., minutely verruculose, spore profile not affected or slightly affected, in SEM minutely echinulate; spinules to 0.2 µm high, spore surface densely punctate between spinules.

Specimen examined — On *Saccharum strictum* (Host) Spreng. – Greece: Rodos island, c. 1 km E of Archangelos, 23 Oct 2003, *M. Ristow* (B 70 0015526).

Note — Sporisorium pulverulentum is a rare species known only from S Europe and S and SE Asia (India, Malaysia and Indonesia) (Vánky 2011; Chalkley 2015). In Europe, it has previously been recorded only from Serbia (Mt Fruška Gora near Novi Sad; Vánky 1985a, b).

Tilletia fusca Ellis & Everh. in J. Mycol. 3: 55. 1887. – Fig. 2A–C.

Sori in ovaries of most spikelets of infected plant, ovoid, 1.5–2.2 mm long, partially concealed by floral envelopes, initially covered by thin, dark brown pericarp that later ruptures exposing powdery, dark reddish brown mass of spores and sterile cells. *Sterile cells* subglobose or broadly ellipsoidal, sometimes slightly irregular, (9.5–)10.5–14.5(–15.5) × (9–)10–13.5(–14.5) µm, hyaline; cell wall 0.9–1.6 µm thick, in SEM smooth. *Spores* globose, subglobose or broadly ellipsoidal, (16.5–)17.5–20.5(–21.5) × (16–)17–19.5 (–20.5) (19.1 ± 1.0 × 18.2 ± 1.0) µm (*n* = 100), light to medium yellow-brown, completely reticulate; spore wall 3–3.8 µm thick (including reticulum and hardly visible, 0.5–0.7 µm-thick inner layer); meshes (5–)6–8(–9) per spore diameter, usually polyhedral, sometimes rounded, (0.9–)1.2–3.5(–4) µm wide; muri 21–29 on equatorial circumference, in optical median view subacute or blunt, (1.2–)1.4–1.8(–2.2) µm high, in SEM some meshes with a low hemispherical protuberance on bottom.

Specimen examined — On *Vulpia ciliata* Dumort. – Greece: Crete, Agia Triada, 27 Mar 1979, *R. Böcker* (B 70 0015527).

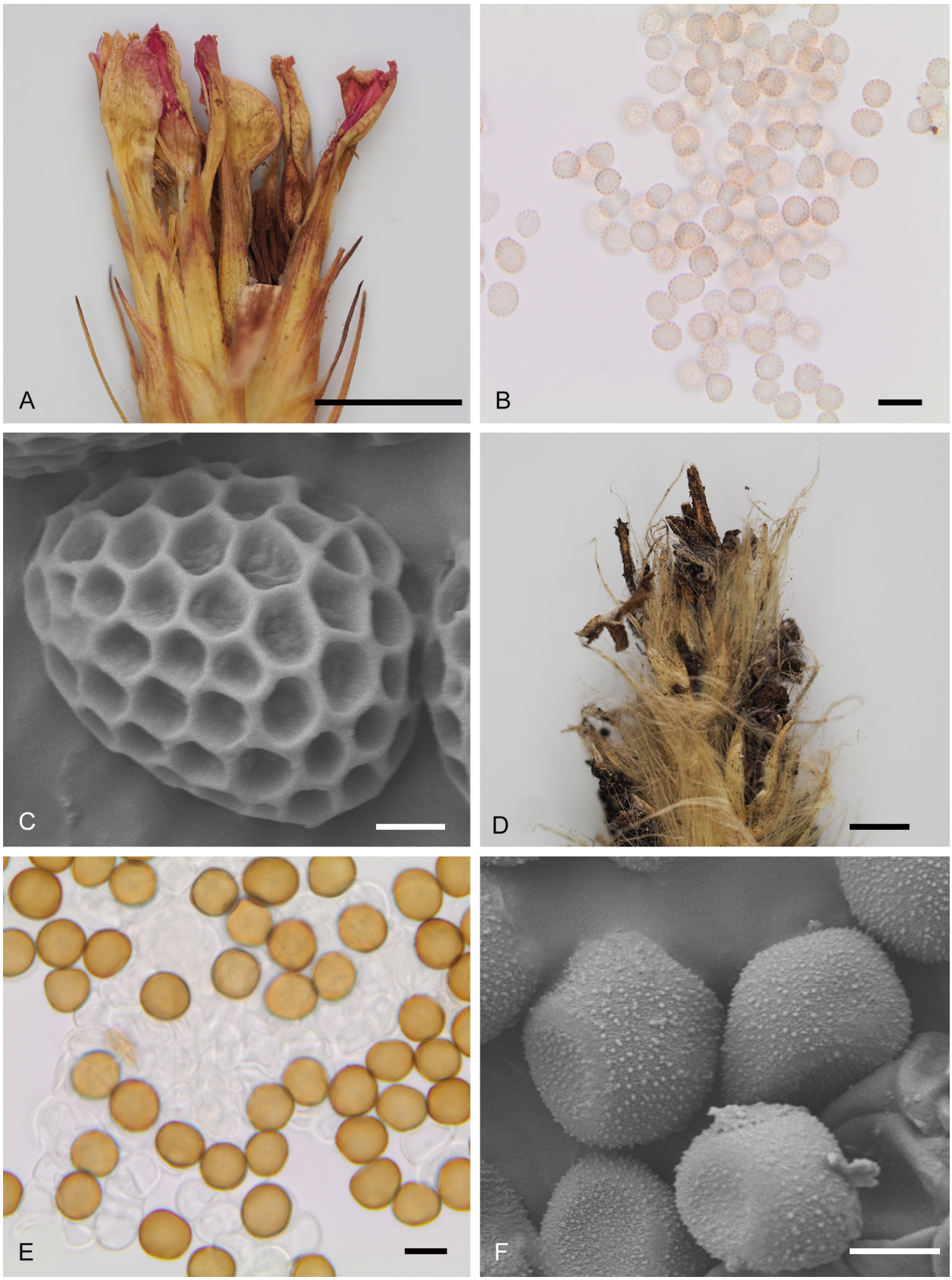

Fig. 1. A–C: *Microbotryum dianthorum* on *Dianthus viscidus* (B 70 0007639); A: habit; B, C: spores in LM and SEM, respectively. – D–F: *Sporisorium pulverulentum* on *Saccharum strictum* (B 70 0015526); D: habit; E, F: spores in LM and SEM, respectively. – Scale bars: A = 0.5 cm, B = 10 µm, C = 1 µm, D = 0.2 cm, E = 10 µm, F = 5 µm.

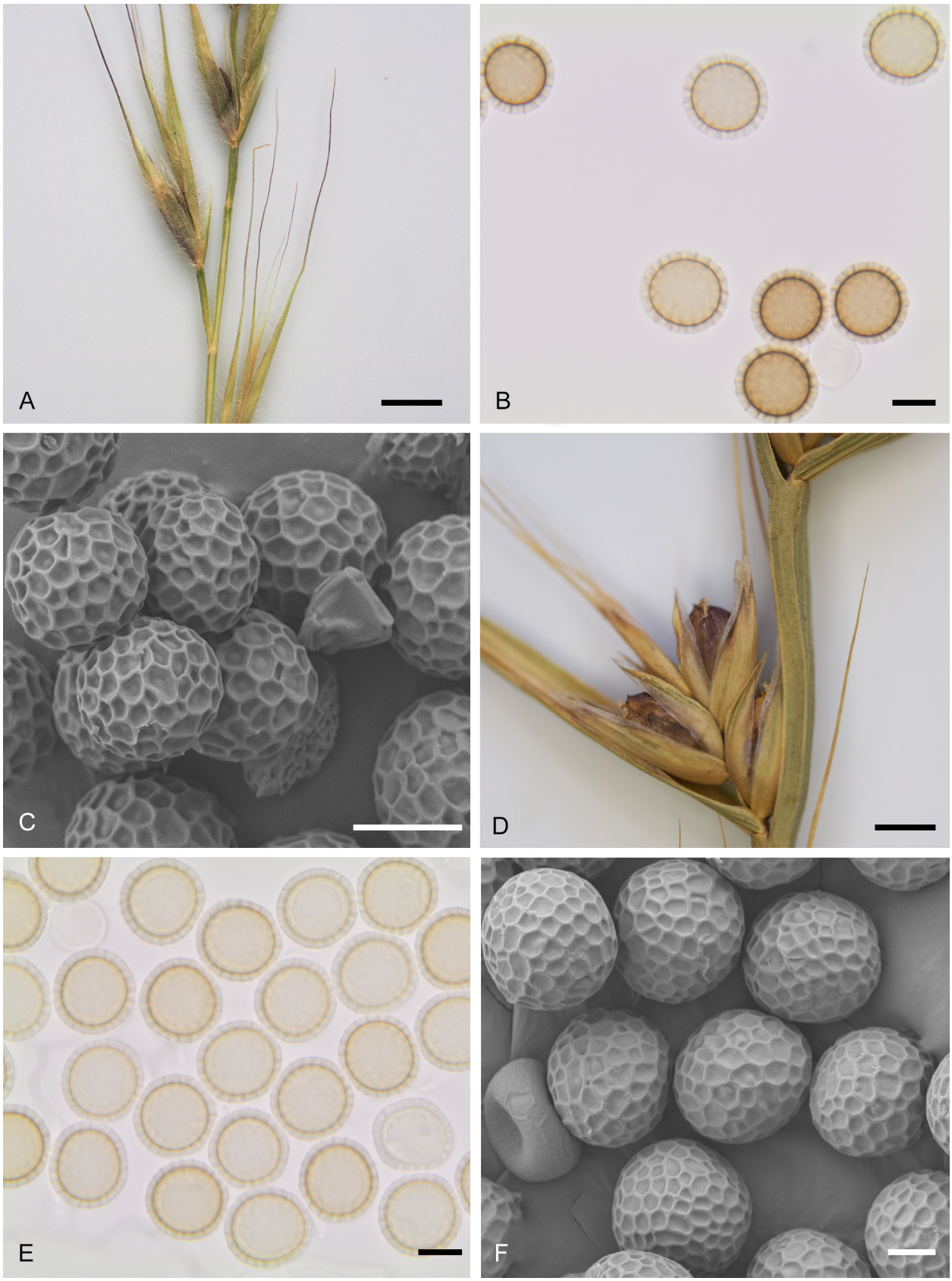

Fig. 2. A–C: *Tilletia fusca* on *Vulpia ciliata* (B 70 0015527); A: habit; B: spores in LM; C: spores and a sterile cell in SEM. – D–F: *Tilletia lolii* on *Lolium temulentum* (B 70 0015546); D: habit; E: spores in LM; F: spores and a sterile cell in SEM. – Scale bars: A = 0.2 cm, B = 10 µm, C = 5 µm, D = 0.2 cm, E = 10 µm, F = 5 µm.

Tilletia lolii Auersw. ex G. Winter, Rabenh. Krypt.-Fl., ed. 2, 1(1): 109. 1881. – Fig. 2D–F.

Sori in all ovaries of infected plant, ovoid, 3–4 × 1.2–1.8 mm, partially concealed by floral envelopes, initially covered by thin, purplish brown pericarp that later ruptures exposing powdery, cinnamon-brown mass of spores and sterile cells. *Sterile cells* subglobose, broadly ellipsoidal or slightly irregular, (11.5–)12.5–15.5(–18) × (10.5–)11.5–14.5(–16.5) µm, subhyaline; cell wall (0.9–)1.2–1.8(–2.3) µm thick, smooth. *Spores* globose, broadly ellipsoidal or subglobose, (18–)18.5–21.5(–23) × (17.5–)18–20(–21) (19.9 ± 0.7 × 19.0 ± 0.6) µm (*n* = 100), light yellow-brown, completely reticulate; spore wall 2.9–4 µm thick (including reticulum and 0.5–0.8 µm-thick inner layer), covered by a hyaline sheath 0.3–0.6 µm thick; meshes (5–)6–7(–8) per spore diameter, usually polyhedral, sometimes rounded, 0.7–3.8(–4.3) µm wide; muri 25–33 on equatorial circumference, in optical median view acute or subacute, 1.3–2.2(–2.5) µm high, in SEM single meshes with a low hemispherical or conical protuberance on bottom.

Specimen examined — On *Lolium temulentum* L. – Greece: Crete, Prov. Rethymno, between the mountain peaks Tsilivdikas and Xilis Korifi near Kali Sikia village, 720 m, 30 May 1983, *Greuter & Matthäs* (B 70 0015546).

Tranzscheliella hypodytes (Schltdl.) Vánky & McKenzie, Smut Fungi New Zealand: 156. 2002, s. lat. – Fig. 3A–C.

Sori around upper internode or around branches of aborted inflorescence, initially covered by upper leaf sheath or spatheole, respectively, later exposed; peridium absent. Spore mass powdery, blackish brown. *Infection* systemic. *Spores* subglobose, globose, broadly ellipsoidal or ovoid, 4–6(–6.5) × 3.5–5.5 (5.0 ± 0.4 × 4.4 ± 0.4) µm (*n* = 100), medium olivaceous brown; spore wall 0.5–0.7 µm thick, smooth or nearly so, often with small, hardly distinguishable hyaline caps at poles, in SEM minutely verruculose; warts flattened, often connected in small irregular groups; surface between main ornaments punctate.

Specimen examined — On *Lygeum spartum* Loefl. ex L. – Greece: Crete, near Ferma, 16 Apr 1994, *H. Scholz & I. Scholz* (as *Ustilago hypodytes* (Schltdl.) Fr., B).

Note — From Greece, *Tranzscheliella hypodytes* is known only on *Achnatherum miliaceum* (L.) P. Beauv. (Maire 1917, as *Ustilago athenae* Maire). *Lygeum spartum* is recorded here as a new host plant of *T. hypodytes* for Greece. There is a second species of *Tranzscheliella* on *L. spartum*, *T. sparti* (Massenot) Vánky, but its sori are restricted to the inflorescence and the spores are larger (6–8 µm long). The sori and spores of the Greek specimen reported here correspond to that of *T. hypodytes* s. lat.

Tranzscheliella williamsii (Griffiths) Dingley & Versluys in New Zealand J. Bot. 15: 477. 1977. – Fig. 3D–F; Fig. 4A.

Sori around upper internodes or aborted inflorescence branches, initially covered by upper leaf sheaths, later exposed. Spore mass powdery, blackish brown. *Infection* systemic. *Spores* slightly flattened, in plane view suborbicular, orbicular or broadly elliptic, sometimes slightly irregular, in plane view (5.5–)6–9(–9.5) × (5–)5.5–7.5(–8) (7.4 ± 0.8 × 6.8 ± 0.5) µm (*n* = 100), medium olivaceous brown; spore wall 0.6–1 µm thick, smooth; exospore often cracked, bearing 2 persistent appendages on flattened sides, in SEM with low, flattened, densely packed ornaments connected in small groups and short rows or forming labyrinthiform pattern.

Specimen examined — On *Stipa isoldeae* H. Scholz. – Greece: Nomos and Eparchia Grevena, Vourinos massif, E of Exharos, 1150 m, serpentinite rocks, 16 Aug 1983, *I. Hagemann*, *H. Ketelhut & H.-J. Wolf 962a*, comm. *H. Scholz* (as *Ustilago williamsii* (Griffiths) Lavrov, B).

Notes — From Greece, *Tranzscheliella williamsii* has been previously recorded only once, as *T. otophora* Lavrov, on *Stipa* sp. (Petrak 1956). The relevant specimen is kept at the Mycological Collection of the Natural History Museum, Vienna (W): Epirus, Distr. Ioanina, Montes Pindus, in monte Tsuka Rossa ditionis pagi Vovousa (Viosa), 1600–1980 m, in pinetis, substr. serpent., 1–2 Aug 1956, *K. H. Rechinger 18586* (K. H. Rechinger, Iter Graecum VIII, 1956; W 1976-04903) (Fig. 3D). This specimen was re-examined by us and its identification was confirmed.

Stipa isoldeae is endemic to Greece. This grass is reported here as a new host of *Tranzscheliella williamsii.*

Urocystis agropyri (Preuss) A. A. Fisch. Waldh. in Bull. Soc. Imp. Naturalistes Moscou 40: 258. 1867.

Sori in leaves, sheaths and culms as long striae, initially covered by epidermis that later ruptures disclosing semi-agglutinated, blackish brown mass of spore balls. *Spore balls* irregular, subglobose, broadly ellipsoidal, ellipsoidal or ovoid, composed of 1–4(or 5) central spores (1 = 26.5 %, 2 = 43.4 %, 3 = 20.3 %, 4 = 7.3 %, 5 = 2.4 %; *n* = 875), surrounded by a continuous or almost continuous layer of sterile cells, (16.5–)18–26(–28.5) × (14.5–)16–20(–21.5) µm [with 1 spore], (20.5–)22.5–29(–33) × (17.5–)19–24.5(–26.5) µm [with 2 spores], (24–)25.5–33(–36) × (19–)21–26.5(–28.5) µm [with 3 spores], (27.5–)29–40(–44.5) × (22.5–)24–29(–31.5) µm [with 4 spores]. *Sterile cells* elliptic, irregular, suborbicular, broadly elliptic, elongate or ovate in outline, collapsed, 4.5–12(–13) µm long, light yellow-brown; cell wall on side distal to spores 0.6–1.1 µm thick,

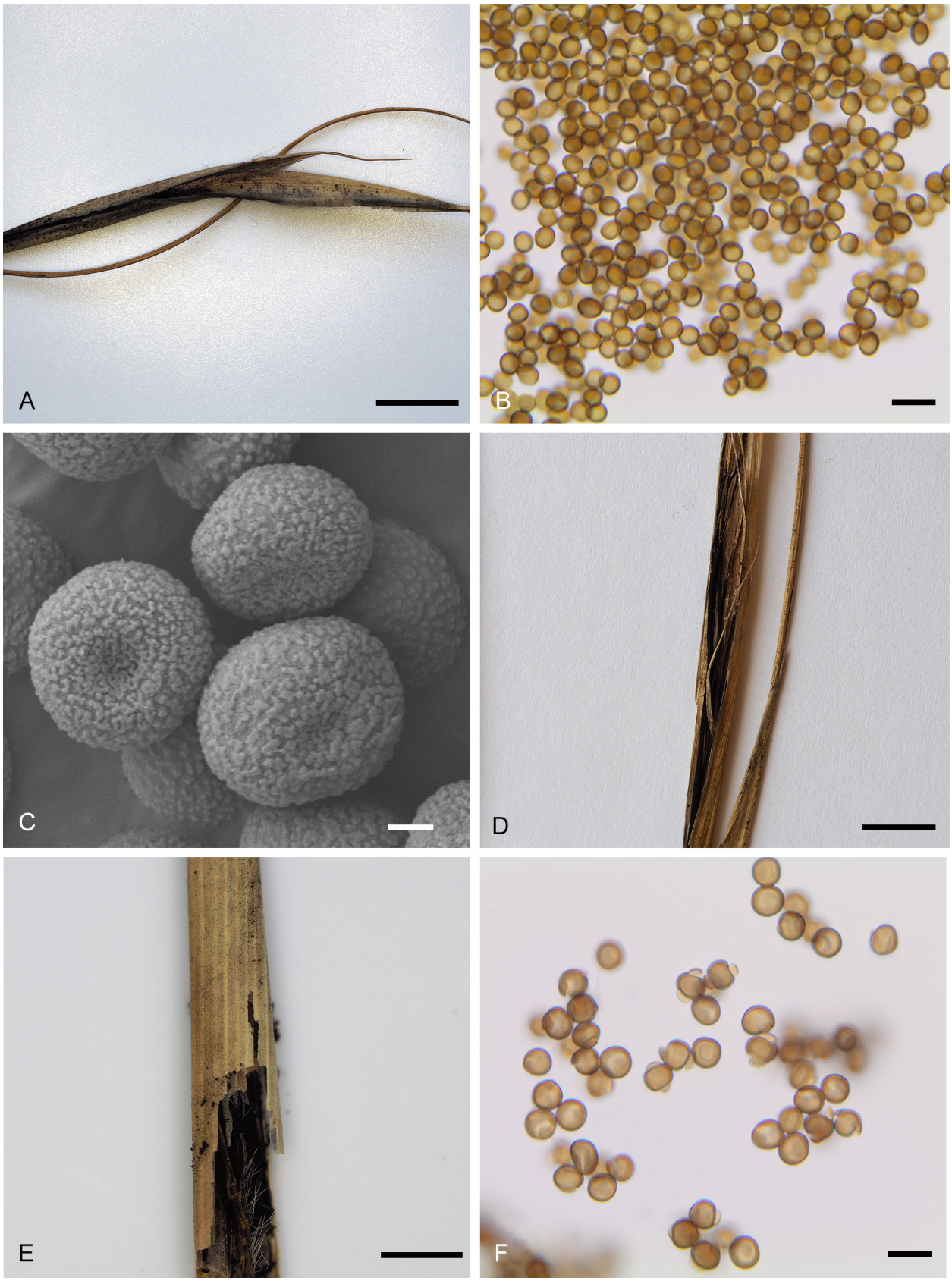

Fig. 3. A–C: *Tranzscheliella hypodytes* on *Lygeum spartum* (B); A: habit; B, C: spores in LM and SEM, respectively. – D: Habit of *Tranzscheliella williamsii* on *Stipa* sp. (W). – E, F: *Tranzscheliella williamsii* on *Stipa isoldeae* (B); E: habit; F: spores in LM. – Scale bars: A = 1 cm, B = 10 µm, C = 1 µm, D = 1 cm, E = 0.2 cm, F = 10 µm,

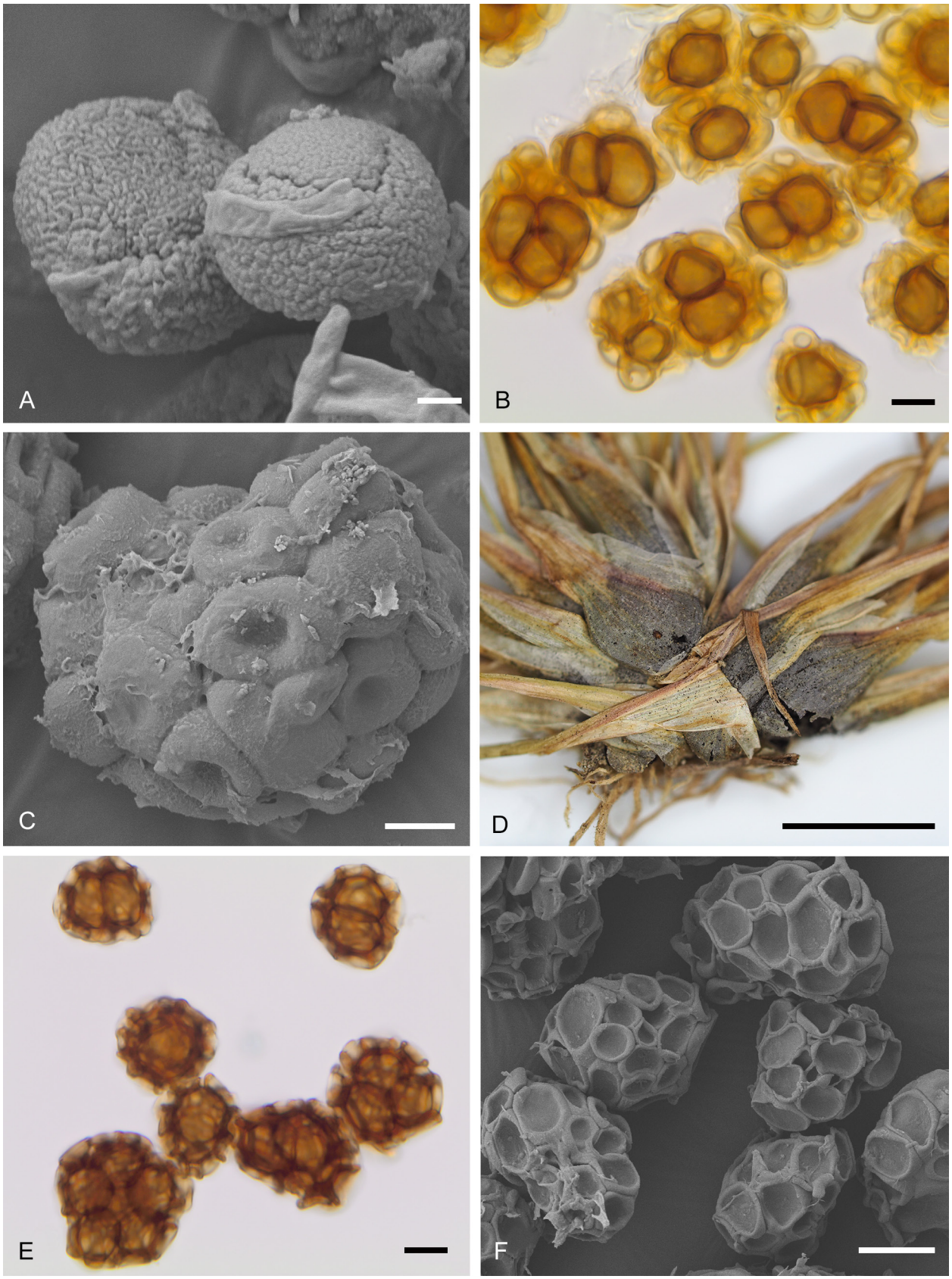

Fig. 4. A: Spores of *Tranzscheliella williamsii* on *Stipa isoldeae* (B) in SEM. – B, C: *Urocystis dactylidina* on *Dactylis glomerata* subsp. *hackelii* (B); B: spore balls in LM; C: spore ball in SEM. – D–F: *Urocystis johansonii* on *Juncus bufonius* (B); D: habit; E, F: spore balls in LM and SEM, respectively. – Scale bars: A = 1 µm, B = 10 µm, C = 5 µm, D = 0.5 cm, E = 10 µm, F = 5 µm.

on side proximal to spores thicker, smooth, in SEM punctate; projections irregularly arranged, often fused. *Spores* broadly ellipsoidal, subpolyhedral, subglobose, ellipsoidal or ovoid, sometimes cuneate or elongate, often slightly flattened on a few places, (11.5–)12.5–17.5(–19.5) × (10–)10.5–14.5(–16) (15.8 ± 1.4 × 12.8 ± 1.2) µm (*n* = 100), medium reddish brown; spore wall slightly uneven, 0.7–1.1 µm thick.

Specimen examined — On *Thinopyrum junceum* (L.) Á. Löve (= *Elymus farctus* (Viv.) Runemark ex Melderis). – Greece: Kos island, Marmari, 1 May 1990, *H. Scholz & I. Scholz* (B).

Note — In some websites, *Urocystis agropyri* is reported from Greece as collected on wheat. In fact, the correct name of the smut fungus in leaves and stems of *Triticum* is *U. tritici* Körn. The only other known record of *U. agropyri* from Greece is on *Thinopyrum junceum* (as *Elymus farctus*) from Kos island (collected on 21 Apr 1990, *H. Scholz & I. Scholz*, Vánky, *Ustilaginales* exsiccata, no. 769, Vánky 1990b). *Urocystis agropyri* in its broad sense represents a species complex (Vánky 2011) that probably contains a few species. For clarification of their number and specialization and whether these species are morphologically recognizable, this complex needs a combined molecular and morphological study. For this reason, we considered that it would be helpful to include here a description of the Greek specimen examined by us on *Thinopyrum junceum*.

Urocystis dactylidina (Lavrov) Zundel in Contr. Dept. Bot. School Agric. Pennsylvania State Coll. 176: 314. 1953. – Fig. 4B, C.

Sori in leaves and sheaths as long striae, initially covered by epidermis that later ruptures disclosing powdery, blackish brown mass of spore balls. *Spore balls* irregular, broadly ellipsoidal, subglobose or ovoid, composed of 1–3(or 4) central spores (1 = 42.5 %, 2 = 45.3 %, 3 = 9.7 %, 4 = 2.5 %; *n* = 746), surrounded by a continuous or almost continuous layer of sterile cells, (18–)20–29(–32) × (16–)17–24(–28) µm [with 1 spore], (24–)26–34(–37) × (18–)20–28(–32) µm [with 2 spores], (29–)31–38(–42) × (23.5–)25–33(–37) µm [with 3 spores]. *Sterile cells* suborbicular, broadly elliptic, irregular, elliptic or ovate in outline, often collapsed, (4.5–)5.5–14(–17) µm long, medium yellow-brown; cell wall irregularly thickened, on side distal to spores 0.7–2.3(–2.6) µm thick, on side proximal to spores thicker, smooth, in SEM punctate; projections sometimes connected, forming fine, irregular pattern. *Spores* subpolyhedral, broadly ellipsoidal, subglobose or ovoid, sometimes ellipsoidal or cuneate, sometimes slightly flattened on a few places, (11.5–)12.5–18.5(–20) × (10–)11–15.5(–16.5) (15.3 ± 1.5 × 13.1 ± 1.2) µm (*n* = 100), medium reddish brown; spore wall slightly uneven, 0.8–1.2(–1.4) µm thick.

Specimen examined — On *Dactylis glomerata* subsp. *hackelii* (Asch. & Graebn.) Cif. & Giacom. – Greece: Dodecanesus, Insula Karpathos, in Insula Mira (Moira), infra pagum Epano Afiartis sita, 35°27'N, 27°11'10"E, 10–40 m, 17 May 1983, *W. Greuter & R. Pleger*, *Plantae Austro-Aegaeae 19738*, det. *H. Scholz* (B).

Note — *Urocystis dactylidina* is a rare species collected only a few times in C Europe (Czech Republic, Switzerland, ?Poland) and Asia (W and E Siberia) (Vánky 1985a, 1994, 2011; Azbukina & Karatygin 1995; Karatygin 2012). Vánky (2011) noted that the host plant identity of all collections, seen by him, was suspected to be wrongly identified. For this reason, *U. dactylidina* needs a purposeful investigation. *Dactylis glomerata* subsp. *hackelii*, reported here, is a new host of *U. dactylidina.*

Urocystis johansonii (Lagerh.) Magnus in Verh. Bot. Vereins Prov. Brandenburg 37: 94. 1896. – Fig. 4D–F.

Sori at basal part of leaves as bulb-like swellings, initially covered by epidermis that later ruptures disclosing powdery, blackish brown mass of spore balls. *Spore balls* subglobose, irregular, broadly ellipsoidal, ovoid or ellipsoidal, composed of 1–5(–9) central spores (1 = 6 %, 2 = 29.6 %, 3 = 35.2 %, 4 = 15.6 %, 5 = 8.8 %, 6 = 2.8 %, 7 = 1 %, 8 = 0.7 %, 9 = 0.3 %; *n* = 609), surrounded by a continuous layer of sterile cells, (13.5–)14.5–20(–21) × (12.5–)13.5–17.5(–18.5) µm [with 1 spore], (18–)20–26(–29) × (14–)16–20(–22) µm [with 2 spores], (21–)22–30(–31.5) × (18–)19–23(–24.5) µm [with 3 spores], (23.5–)25–33(–35) × (19.5–)21–26(–28.5) µm [with 4 spores], (27–)29–41(–45) × (20–)22–31(–33) µm [with 5 spores]. *Sterile cells* irregular, suborbicular, broadly elliptic or ovate in outline, collapsed, 3.5–13(–15) µm long, light or medium yellow-brown; cell wall on side distal to spores 0.5–0.8 µm thick, on side proximal to spores thicker, smooth, in SEM smooth. *Spores* subglobose, broadly ellipsoidal, slightly irregular, ellipsoidal or ovoid, sometimes slightly flattened on a few places, 10.5–15(–16) × (8–)9–12(–13) (13.0 ± 1.0 × 10.7 ± 0.8) µm (*n* = 100), dark reddish brown; spore wall slightly uneven, 0.9–1.4(–1.6) µm thick.

Specimen examined — On *Juncus bufonius* L. – Greece: Crete, [Prov. Iraklio], between Kasteli and Karouzana, 17 Apr 1994, *H. Scholz & I. Scholz* (B).

Urocystis ornithogali Körn. ex A. A. Fisch. Waldh., Aperçu Syst. Ustilag.: 41. 1877. – Fig. 5A–C.

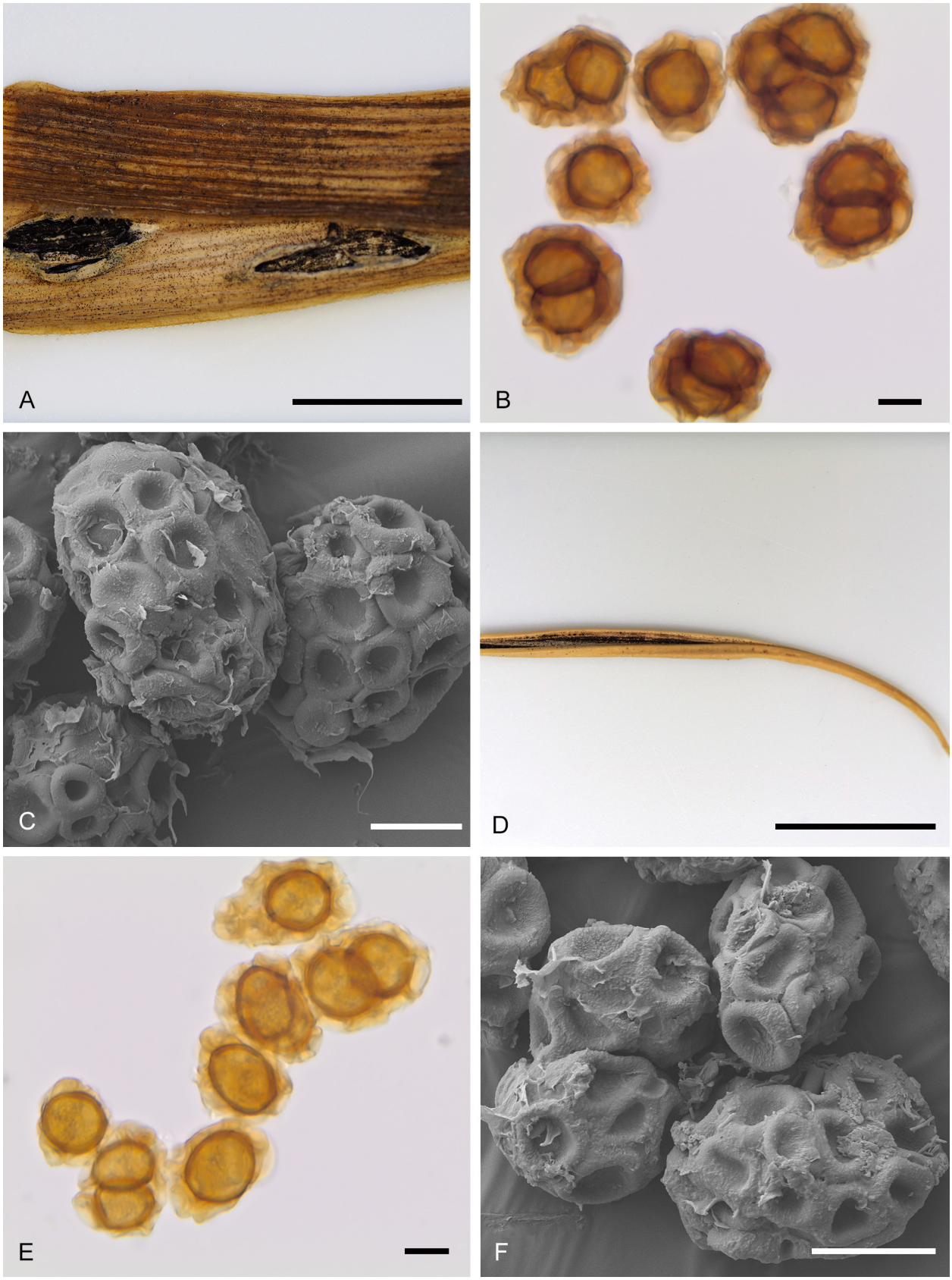

Fig. 5. A–C: *Urocystis ornithogali* on *Ornithogalum* sp. (B); A: habit; B, C: spore balls in LM and SEM, respectively. – D–F: *Urocystis ulei* on *Festuca jeanpertii* (B); D: habit; E, F: spore balls in LM and SEM, respectively. – Scale bars: A = 0.5 cm, B, C = 10 µm, D = 0.5 cm, E, F = 10 µm.

Sori in leaves and stems as small to large pustules, initially covered by epidermis that later ruptures disclosing powdery, blackish brown mass of spore balls. *Spore balls* irregular, broadly ellipsoidal, subglobose or ovoid, composed of 1–3(–5) central spores (1 = 31 %, 2 = 41.7 %, 3 = 21.1 %, 4 = 5.3 %, 5 = 0.9 %; *n* = 546), surrounded by a continuous layer of sterile cells, (18–)20–26(–28) × (16.5–)18–23(–25.5) µm [with 1 spore], (22–)25–33(–35) × (19.5–)21–26(–28) µm [with 2 spores], (24.5–)27–40(–44) × (22.5–)25–32(–35) µm [with 3 spores]. *Sterile cells* irregular, suborbicular, orbicular or ovate in outline, collapsed, 5–13(–15) µm long, light or medium yellow-brown; cell wall on side distal to spores 0.4–0.8 µm thick, on side proximal to spores thicker, smooth, in SEM smooth to sparcely punctate. *Spores* subpolyhedral, broadly ellipsoidal, subglobose or cuneate, sometimes slightly flattened on a few places, (13–)14.5–20.5(–22.5) × (10.5–)11.5–16(–17) (17.3 ± 1.4 × 14.2 ± 1.0) µm (*n* = 100), medium reddish brown; spore wall slightly uneven, 0.7–1 µm thick.

Specimen examined — On *Ornithogalum* sp. – Greece: Euböa [Evvia], E of Eretria, near hotel Miramare, 19 Mar 1991, *H. Scholz & I. Scholz* (B).

Urocystis ulei Magnus in Rabenhorst, Fungi Europ. exsicc. 17: no. 2390. 1878. – Fig. 5D–F.

Sori in leaves and sheaths (infected plants usually sterile) as long, slightly swollen striae, initially covered by epidermis that later ruptures disclosing powdery, blackish brown mass of spore balls. *Spore balls* subglobose, broadly ellipsoidal, irregular, ellipsoidal or ovoid, composed of 1 or 2(–4) central spores (1 = 78.4 %, 2 = 16.6 %, 3 = 4.2 %, 4 = 0.8 %; *n* = 529), surrounded by a continuous or almost continuous layer of sterile cells, (14.5–)16–27(–29) × (12–)13.5–22(–23.5) µm [with 1 spore], (17.5–)20–34(–38) × (14.5–)16–25(–27) µm [with 2 spores], (27–)29–37(–40) × (22–)24–32 (–35) µm [with 3 spores]. *Sterile cells* suborbicular, orbicular, irregular, broadly elliptic, elliptic or ovate in outline, collapsed, (5–)6–13(–15) µm long, light or medium yellow-brown; cell wall on side distal to spores 0.5–0.7 µm thick, on side proximal to spores thicker, smooth, in SEM punctate. *Spores* subglobose, broadly ellipsoidal, subpolyhedral, slightly irregular, ellipsoidal or ovoid, sometimes elongate, sometimes slightly flattened on a few places, (11.5–)13–17(–19.5) × (10–)11–14.5(–15.5) (14.8 ± 1.4 × 12.7 ± 1.2) µm (*n* = 100), medium reddish brown; spore wall slightly uneven, 0.8–1.5 µm thick.

Specimen examined — On *Festuca jeanpertii* (St.-Yves) Markgr. – Greece: Sterea Ellas, Prov. Fokis, Vardousia massif, S of Kato Mousounitsa, 1600 m, 27 Jun 1982, *H. Scholz* (B).

Note — Festuca jeanpertii is a new host for *Urocystis ulei.*

Acknowledgements

This research received support from the SYNTHESYS Project (http://www.synthesys.info/), which is financed by European Community Research Infrastructure Action under the FP7 "Capacities" Program (grants no. DE-TAF-4056 to C. M. Denchev, and NL-TAF-4973 to T. T. Denchev). The assistance of Dr Harrie J. M. Sipman (Botanic Garden and Botanical Museum Berlin) and Bertie-Joan van Heuven (SEM lab of Naturalis Biodiversity Center, Leiden, The Netherlands) is kindly acknowledged. We also thank Kálmán Vánky and an anonymous reviewer for their comments on an earlier version of this paper.

References

Apostolides C. A. 1952: Contribution to the mycological flora of Greece. – Ann. Inst. Phytopathol. Benaki **6:** 62–78.

Azbukina Z. M. & Karatygin I. V. 1995: Ordo *Ustilaginales.* Fasc. 2. Familia *Tilletiaceae.* – In: Melnik V. A. (ed.), Definitorium Fungorum Rossiae. – Sankt Peterburg: Nauka. [In Russian].

Bornmüller J. 1894: Nachtrag zu „Florula insulae Thasos". – Österr. Bot. Z. **44:** 212–216.

Bornmüller J. 1928: Ergebnis einer botanischen Reise nach Griechenland II. im Jahre 1926 (Zante, Cephallonia, Achaia, Phokis, Aetolien). – Repert. Spec. Nov. Regni Veg. **25:** 270–350.

Brandenburger W. 1969: Parasitische Pilze von Kreta. Gleichzeitig ein Beitrag zur Biometrik der Sporen. – Sydowia **22:** 108–159.

Braun U. 2013: Fungi selecti exsiccati ex Herbario Universitatis Halensis – nos. 191–200. – Schlechtendalia **25:** 53–55.

Chalkley D. 2015: *Sporisorium* smut of wild *Saccharum* – *Sporisporium pulverulentum.* Systematic Mycology and Microbiology Laboratory, ARS, USDA. – Published at http://nt.ars-grin.gov/taxadescriptions/factsheets/index.cfm?thisapp=Sporisoriumpulverulentum [accessed 23 Dec 2015].

Critopoulos P. D. 1953: A contribution on the fungus flora of Greece. – Bull. Torrey Bot. Club **80:** 325–341.

Demetriades S. D. & Zachos D. G. 1962: Rapport sommaire sur les maladies des plantes cultivées, observées en Grèce au cours des années 1960 et 1961. – Ann. Inst. Phytopathol. Benaki, Nouv. Ser. **4:** 75–88.

Denchev C. M. 1997: Additional finds of *Microbotryum violaceo-verrucosum* (*Ustilaginales*). – Bocconea **5:** 849–852.

Denchev C. M. & Minter D. W. 2008: *Microbotryum silenes-inflatae.* – IMI Descriptions of Fungi and Bacteria no. 1763. – Egham: CAB International.

Denchev C. M. & Minter D. W. 2011a: *Anthracoidea irregularis.* – IMI Descriptions of Fungi and Bacteria no. 1863. – Egham: CAB International.

Denchev C. M. & Minter D. W. 2011b: *Anthracoidea sempervirentis.* – IMI Descriptions of Fungi and Bacteria no. 1868. – Egham: CAB International.

Denchev T. T., Denchev C. M., Michikawa M. & Kakishima M. 2013: The genus *Anthracoidea* (*Anthracoideaceae*) in Japan and some adjacent regions. – Mycobiota **2:** 1–125.

Dimopoulos P., Raus Th., Bergmeier E., Constantinidis Th., Iatrou G., Kokkini S., Strid A. & Tzanoudakis D. 2013: Vascular plants of Greece: an annotated checklist. – Berlin: Botanischer Garten und Botanisches Museum Berlin-Dahlem; Athens: Hellenic Botanical Society. – Englera **31.**

Durrieu G. 1968: Micromycetes parasites de Grèce. – Biol. Gallo-Hellen. **1:** 65–83.

Hohenbühel L. L. B. 1868: VI. Fungos. – In: Heufler (ed.), Specimen florae cryptogamae septem insularum. – Verh. Zool.-Bot. Ges. Wien **18:** 427–428.

Karatygin I. V. 2012: Smut fungi in the European part of Russia. A preliminary checklist. – Mikol. Fitopatol. **46:** 41–53. [In Russian].

Kashefi J. & Vánky K. 2004: *Microbotryum scolymi*, a rare smut fungus new for Greece. – J. Pl. Pathol. **86:** 157–159.

Konstantinia-Sulidu A. 1939: Parasitische Pilze Mazedoniens. – Hedwigia **78:** 284–298.

Magnus P. 1894: Beitrag zur Kenntnis einiger parasitischer Pilze der Mittelmeergebiete. – Ber. Deutsch. Bot. Ges. **12:** 84–88.

Maire R. 1905: Notes sur quelques champignons nouveaux on peu connus. – Bull. Soc. Mycol. France **21:** 137–167.

Maire R. 1917: Champignons nord-africains nouveaux on peu connus. – Bull. Soc. Hist. Nat. Afrique N. **18:** 134–200.

Maire R. & Politis J. 1940: Fungi hellenici. – Actes Inst. Bot. Univ. Athènes **1:** 27–179.

Petrak F. 1943: Fungi. – Pp. 9–26 in: Rechinger K. H., Neue Beiträge zur Flora von Kreta. (Ergebnisse einer biologischen Forschungsreise nach dem Peloponnes und nach Kreta 1942 […]). – Denkschr. Akad. Wiss. Wien, Math.-Naturwiss. Kl. **105(2, 1).**

Petrak F. 1944 ["1943"]: Fungi. – Pp. 10–15 in: Rechinger K. H., Flora aegaea. Flora der Inseln und Halbinseln des ägäischen Meeres. – Denkschr. Akad. Wiss. Wien, Math.-Naturwiss. Kl. **105(1).**

Petrak F. 1956: Ein kleiner Beitrag zur Pilzflora Griechenlands. – Sydowia **10:** 306–315.

Pyrowolakis E. & Weltzien H. C. 1970: Phytopathologische Beobachtungen auf der Insel Kreta. – Z. Pflanzenkrankh. Pflanzenschutz **77:** 368–386.

Sarejanni J. A. 1935: Liste I des maladies des plantes cultivées et autres de la Grèce. – Ann. Inst. Phytopathol. Benaki **1:** 13–20.

Sarejanni J. A. 1939: Catalogue commenté des champignons rencontrés sur les plantes cultivées en Grèce. – Ann. Inst. Phytopathol. Benaki **3:** 41–66.

Savchenko K. G., Carris L. M., Castlebury L. A., Heluta V. P. & Nevo E. 2014: Revision of *Entyloma* (*Entylomatales*, *Exobasidiomycetes*) on *Eryngium.* – Mycologia **106:** 797–810.

Săvulescu T. 1937: Eine neue *Ustilago*-Art, *Ustilago rechingeri* Săvul. – Ann. Mycol. **35:** 50–52.

Scheuer C. 1992: Reliquiae Petrakianae. Alphabetisches Gesamtverzeichnis und Corrigenda (cumulative index and corrigenda). – Graz: Institut für Botanik der Karl-Franzens-Universität.

Scheuer C. 2010: Dupla graecensia fungorum (2010, Nos 101–200). – Fritschiana **66:** 10–46.

Scholz H. & Scholz I. 1988: Die Brandpilze Deutschlands (*Ustilaginales*). – Englera **8:** 1–691.

Sydow H. 1935: Ein Beitrag zur Kenntnis der parasitischen Pilze der Mittelmeergebiete. – Svensk Bot. Tidskr. **29:** 66–78.

Thiers B. 2016+ [continuously updated]: Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's virtual herbarium. – Published at http://sweetgum.nybg.org/science/ih/ [last accessed 13 Jul 2016].

Triebel D. 1998: Microfungi exsiccati. Fasc. 11–14 (No. 251–350). – Arnoldia **15:** 1–43.

Triebel D. 1999: Microfungi exsiccati. Fasc. 15–18 (No. 351–450). – Arnoldia **17:** 1–43.

Vánky K. 1980: *Ustilaginales.* Fasc. XI–XIII (No. 251–325). – Publ. Herb. Univ. Uppsala **5:** 1–25.

Vánky K. 1985a: Carpathian *Ustilaginales.* – Symb. Bot. Upsal. **24(2):** 1–309.

Vánky K. 1985b: K. Vánky, *Ustilaginales* exsiccata. Fasc. XIX–XX (No. 451–500). – Publ. Herb. Ustil. Vánky **1:** 1–17.

Vánky K. 1986: K. Vánky, *Ustilaginales* exsiccata. Fasc. XXIII–XXIV (No. 551–600). – Publ. Herb. Ustil. Vánky **4:** 1–17.

Vánky K. 1989: K. Vánky, *Ustilaginales* exsiccata. Fasc. XXVII–XXIX (No. 651–725). – Publ. Herb. Ustil. Vánky **6:** 1–25.

Vánky K. 1990a: Taxonomical studies on *Ustilaginales.* V. – Mycotaxon **36:** 473–482.

Vánky K. 1990b: K. Vánky, *Ustilaginales* exsiccata. Fasc. XXX–XXXII (No. 726–800). – Publ. Herb. Ustil. Vánky **7:** 1–25.

Vánky K. 1991: Taxonomical studies on *Ustilaginales.* VIII. – Mycotaxon **41:** 483–495.

Vánky K. 1992: K. Vánky, *Ustilaginales* exsiccata. Fasc. XXXIII–XXXVI (No. 801–900). – Publ. Herb. Ustil. Vánky **8:** 1–34.

Vánky K. 1994: European smut fungi. – Stuttgart: Gustav Fischer.

Vánky K. 1996: K. Vánky, *Ustilaginales* exsiccata. Fasc. XXXIX–XL (No. 951–1000). – Publ. Herb. Ustil. Vánky **10:** 1–17.

Vánky K. 1998: K. Vánky, *Ustilaginales* exsiccata. Fasc. XLI–XLII (No. 1001–1050). – Publ. Herb. Ustil. Vánky **12:** 1–17.
Vánky K. 2003a: The smut fungi (*Ustilaginomycetes*) of *Hyparrhenia* (*Poaceae*). – Fungal Diversity **12:** 179–205.
Vánky K. 2003b: K. Vánky, *Ustilaginales* exsiccata. Fasc. XLVII–XLVIII (No. 1151–1200). – Publ. Herb. Ustil. Vánky **15:** 1–17.
Vánky K. 2008: Taxonomic studies on *Ustilaginomycetes* – 28. – Mycotaxon **106:** 133–178.
Vánky K. 2011: Smut fungi of the world. – St. Paul: APS Press.
Vánky K. & Berner D. 2003: *Microbotryum silybum* sp. nov. (*Microbotryales*). – Mycotaxon **85:** 307–311.
Vánky K. & Oberwinkler F. 1994: The smut fungi of *Polygonaceae*, a taxonomic revision. – Nova Hedwigia Beih. **107:** 1–96.
Vánky K. & Scholz H. 2001: Three new species of smut fungi (*Ustilaginomycetes*). – Nova Hedwigia **72:** 391–398.
Vánky K., Jage H. & Scholz H. 2005: Three smut fungi new for Europe. – Nova Hedwigia **80:** 387–395.

Willdenowia
Open-access online edition www.bioone.org/loi/will BioOne
Online ISSN 1868-6397 · Print ISSN 0511-9618 · Impact factor 0.500
Published by the Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin