Polish Botanical Journal 51(2): 165–172, 2006

ENTYLOMA CREPIDIS-TECTORI AND *UROCYSTIS DESCHAMPSIAE*, TWO NEW SMUT FUNGI FROM EUROPE

MARCIN PIĄTEK

Abstract. Two new smut fungi (Ustilaginomycetes) are described and illustrated from Europe: *Entyloma crepidis-tectori* M. Piątek *sp. nov.*, causing leaf spots on *Crepis tectorum* L. in Denmark, and *Urocystis deschampsiae* M. Piątek *sp. nov.*, forming long striae between the veins of *Deschampsia caespitosa* (L.) P. Beauv. in Iceland. *E. crepidis-tectori* is the third *Entyloma* de Bary species known on *Crepis* L. (Asteraceae). The species is similar to *E. zacintha* Vánky infecting *Crepis zacintha* (L.) Loisel. in Greece, from which it differs by possessing larger, commonly irregular spores with a slightly thicker spore wall. *U. deschampsiae* is the first *Urocystis* Rabenh. *ex* Fuckel species on *Deschampsia* P. Beauv., but the eighth *Urocystis* infecting grasses belonging to the subtribe Aveninae (Poaceae). The new species differs from all of them by the number and frequency of spores per spore ball as well as by the sizes of the spore balls, spores and/or sterile cells.

Key words: *Entyloma*, *Urocystis*, Ustilaginomycetes, new species, Denmark, Iceland

Marcin Piątek, Department of Mycology, W. Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL-31-512 Kraków, Poland; e-mail: mpiatek@ib-pan.krakow.pl

INTRODUCTION

Ustilaginomycetes of Europe are well explored thanks to the long tradition of research on these fungi, dating back at least to the 19th century, and synthesized in the monograph of Vánky (1994). However, even here it is possible to find and describe new species using both classical and/or molecular taxonomy. During the last decade, seven new smut fungi were described from Europe: *Schizonella intercedens* Vánky & A. Nagler (Vánky 1998), *Tilletia catapodii* H. Scholz & Vánky (Vánky & Scholz 2001), *Microbotryum silybium* Vánky & D. Berner (Vánky & Berner 2003), *Entyloma bergeniae* Vánky & Döbbeler (Vánky 2005), *Entyloma cosmi* Vánky, H. Horita & H. Jage (Vánky *et al.* 2005), detected by classical taxonomic methods, and *Microbotryum chloranthae-verrucosum* M. Lutz, Göker, M. Piątek, Kemler, Begerow & Oberw. and *M. saponariae* M. Lutz, Göker, M. Piątek, Kemler, Begerow & Oberw., described on the basis of combined molecular and classical taxonomy (Lutz *et al*. 2005). Examination of herbarium materials revealed two further new species belonging to the genera *Entyloma* de Bary and *Urocystis* Rabenh. *ex* Fuckel, respectively.

Entyloma crepidis-tectori M. Piątek, *sp. nov.* (Figs 1–5)

[MycoBank MB 510076]

Typus in matrice Crepis tectorum L.*, Denmark, Jutlandia, prope Ryga, Juli 1911, leg. C. Ferdinandsen [HOLOTYPUS: BPI 174632!].*

Sori in foliis sicut maculae rotundae vel angulares, cinerescentibrunneae, 1–3 mm diametro. Sporae dense aggregatae in lacunis intercellularibus mesophylli, globosae, ellipsoidales usque irregulares, luteolae, (13–)15–21(–22) × (10–)13–18(–20) µm; pariete inaequali, 2–5(–7) µm crasso, levi, raro vestigium hyphae sporogenae breve. Anamorpha non observata.

Sori in the leaves as rounded or angular, greyish-brown spots, 1–3 mm in diameter. Spores densely crowded in intercellular spaces of the mesophyll, globose, ellipsoidal, commonly irregular by mutual pressure, yellowish, (13–)15–21(–22) × (10–)13–18(–20) µm; wall uneven, 2–5(–7) µm

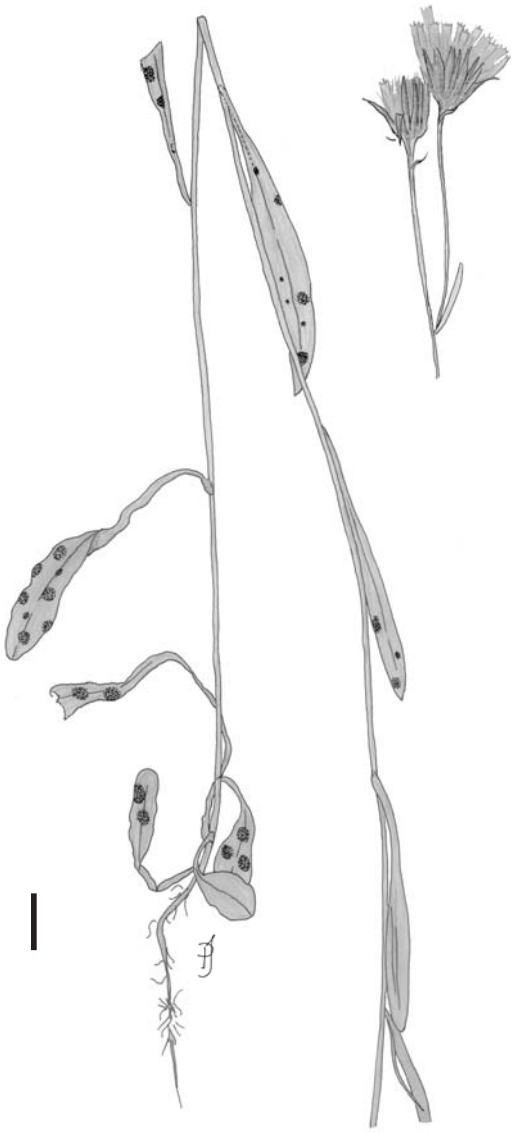


Fig. 1. Sori of *Entyloma crepidis-tectori* M. Piątek *sp. nov.* on *Crepis tectorum* L. (holotype: BPI 174632). Scale bar = 1 cm.

thick, thickest at the angles, smooth, rarely bearing a short remnant of sporogenous hypha. Anamorph not observed.

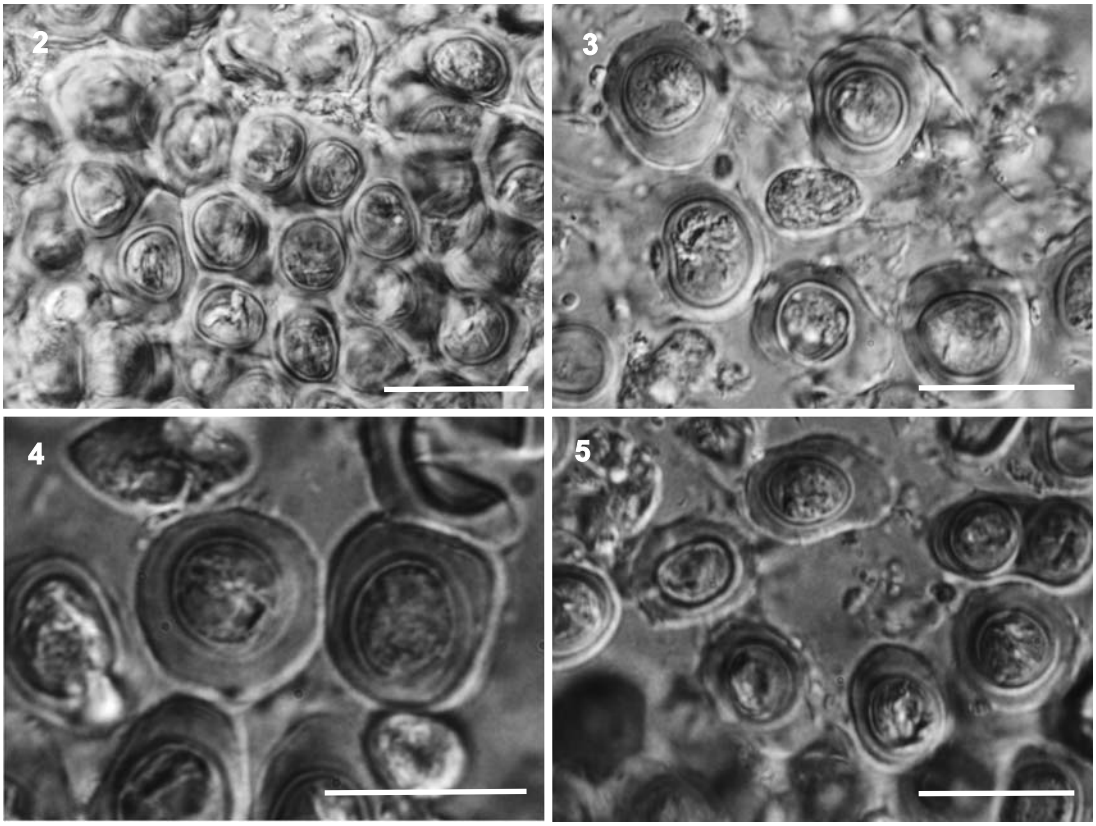
HOST AND DISTRIBUTION. On Asteraceae: *Crepis tectorum* L.; Denmark, Europe. Known only from the type collection (but see below).

Because of the simple morphology of the sori and spores, species delimitation in the genus *Entyloma* is based mostly on host plant criteria. As a rule, species of *Entyloma* are considered distinct if they occur on different host genera, or if they occur on the same host genus but show different morphological characters (comp. Vánky 1994; Begerow *et al.* 2002; Vánky & McKenzie 2002).

Until now, four species of *Entyloma* have been originally described as infecting species of *Crepis* L. The oldest of them is *Entyloma crepidicola* Trotter (Trotter 1908; Vánky 1994), described from the roots of *Crepis bulbosa* (L.) Tausch, collected and hitherto known only from the type locality in Italy. The host plant is now included in the genus *Aetheorhiza* Cass. as *Aetheorhiza bulbosa* (L.) Cass. The other species is *Entyloma crepidis-rubrae* (Jaap) Liro (Liro 1938; Vánky 1994), described on *Crepis rubra* L. from Yugoslavia (now Croatia). Later it was also found on this host in Italy (Zundel 1953), on *Crepis alpina* L. in Azerbaijan (Azbukina & Karatygin 1995) and on *Crepis capillaris* (L.) Wallr. in England (Spooner 2000).

Kawecka-Starmachowa (1939) described *Entyloma crepidis* Kawecka-Starmachowa on *Crepis praemorsa* Tausch from the Ukrainian Carpathians. However, in this case the host plant was misidentified and actually is a *Hieracium* L. species (of the *murorum* group) infected by *Entyloma hieracii* Syd. & P. Syd. *ex* Cif. (Vánky 1990; Piątek 2002). The last species described on *Crepis* is *Entyloma zacintha* Vánky (Vánky 1990) forming spots on the leaves of *Crepis zacintha* (L.) Loisel. in Greece.

Entyloma crepidis-tectori differs from the two hitherto known species of *Entyloma* on true *Crepis* species by the morphological characters of the sori and spores. *Entyloma crepidis-rubrae* has slightly thickened sori and smaller spores, 12–18 × 9–15 μm, with a thinner spore wall, 1.5–3.5 μm. The more similar species is *E. zacintha*, and Vánky (1994) even suspected that collections of *Entyloma* on *Crepis tectorum* from Europe may belong to this very species, but apparently did not study the voucher specimens. However, the spores of *E. zacintha* are also smaller, 13–19 × 10–15 μm, with a slightly thinner spore wall, 1.5–4.0(–5.0) μm, in



Figs 2–5. Spores of *Entyloma crepidis-tectori* M. Piątek *sp. nov.* as seen by LM (holotype: BPI 174632). Scale bars = 20 μm.

comparison with *Entyloma crepidis-tectori*. The host plant is also important in the delimitation of the two *Entyloma* species.

The new species is described based on a collection from Denmark. However, plants of *Crepis tectorum* with symptoms of *Entyloma* infection were also recorded from the Czech Republic (Vánky 1985, as *E. crepidis*; Kokeš & Müller 2004, as *E. zacintha*) and Norway (Jørstad 1963, as *E. picridis*). Very probably they belong to *E. crepidis-tectori* as well.

It is not unusual for several species of *Entyloma* to be known on the same host genus; for instance, two species are known on *Cosmos* Cav. and *Dahlia* Cav., three on *Senecio* L., and four on *Bidens* L. and *Hydrocotyle* L. The three recognized *Entyloma* on true *Crepis* species can be identified using the following key.

KEY TO THE *ENTYLOMA* SPECIES INFECTING *CREPIS*

1. Sori callous. Spore wall up to 3.5 μm thick . . . . . *E. crepidis-rubrae*
1*. Sori not callous. Spore wall up to 5 μm thick . . . 2
2. Spores 15–21 × 13–18 μm, wall 2–5 μm thick . . . . . *E. crepidis-tectori*
2*. Spores 13–19 × 10–15 μm, wall 1.5–4.0 μm thick . . . . . .*E. zacintha*

Urocystis deschampsiae M. Piątek, *sp. nov.* (Figs 6–15)

[MycoBank MB 510077]

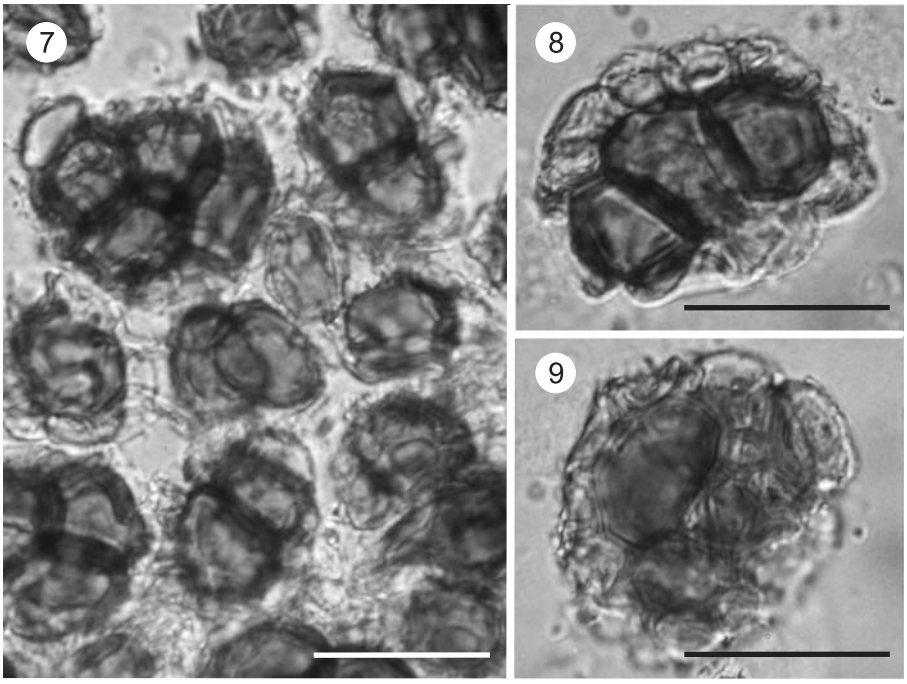
Typus in matrice Deschampsia caespitosa (L.) P. Beauv., *Iceland, S-Þingeyjarsýsla: Húsavík, 15 Juli 1937, leg. I. Jørstad [HOLOTYPUS: O 187139!].*

Sori in foliis, primo epidermide obtectas, deinde rupturas. Glomeruli sporarum subglobosi, ovoidei, ellipsoi-

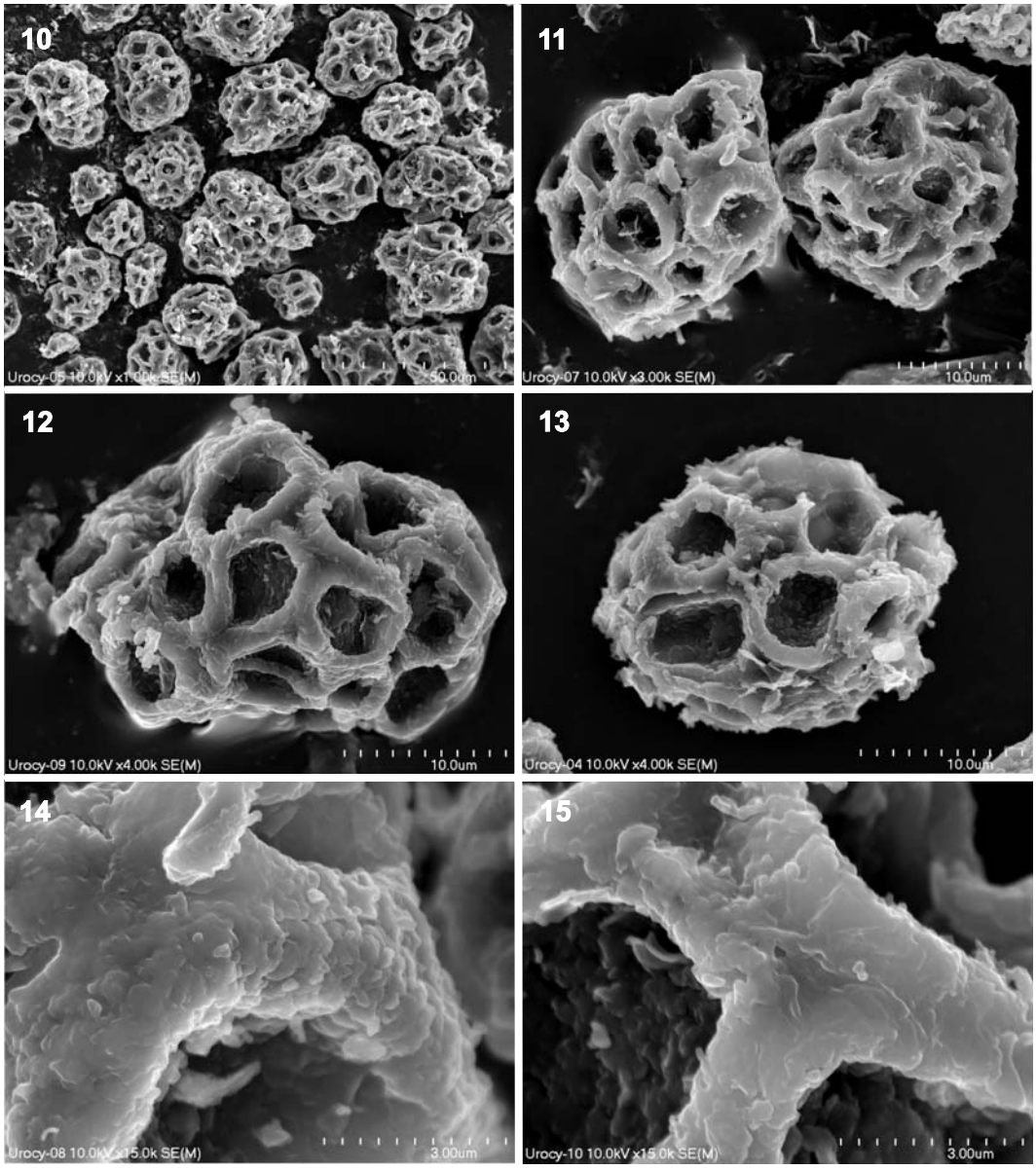
Fig. 6. Sori of *Urocystis deschampsiae* M. Piątek *sp. nov*. on *Deschampsia caespitosa* (L.) P. Beauv. (holotype: O 187139). Scale bar = 1 cm.

dales usque irregulares, (15–)20–40(–48) × 15–30(–32) µm, e sporis 1–4(–6) compositi (1 – 30%, 2 – 42%, 3 – 17%, 4 – 9%, 5 – 1%, 6 – 1%), cellulis sterilibus complete circumdati, raro incomplete circumdati. Sporae globosae, subglobosae usque ovoideae, brunneae, (12–)13–17 ×10–13(–15) µm. Cellulae steriles globosae, subglobosae usque irregulares, plerumque cum lateribus contactis deplanatis, flavae, 7–10(–13) × (5–)6–8(–9) µm, pariete aequali, 1 µm crasso, sub LM levi, sub SEM verruculoso.

Sori in leaves, forming long striae between the veins, at first covered by the epidermis, which later ruptures exposing the blackish, powdery mass of spore balls. Spore balls subglobose, ovoid, ellipsoidal to irregular, (15–)20–40(–48) × 15–30(–32) µm, composed of 1–4(–6) central spores (1 – 30%, 2 – 42%, 3 – 17%, 4 – 9%, 5 – 1%, 6 – 1%), usually completely surrounded by a layer (sometimes not complete) of sterile cells. Spores globose, subglobose to ovoid, brown, (12–)13–17 × 10–13(–15) µm. Sterile cells globose, subglobose to irregular, usually with flattened contact sides, yellowish, 7–10(–13) × (5–)6–8(–9) µm, wall *ca* 1 µm thick, smooth in LM, verruculose in SEM.



Figs 7–9. Spore balls of *Urocystis deschampsiae* M. Piątek *sp. nov*. as seen by LM (holotype: O 187139). Scale bars = 20 µm.



Figs 10–15. Spore balls of *Urocystis deschampsiae* M. Piątek *sp. nov*. as seen by SEM (holotype: O 187139). Note the verruculose surface of the sterile cells, visible especially in Figures 14 and 15.

HOST AND DISTRIBUTION. On Poaceae: *Deschampsia caespitosa* (L.) P. Beauv.; Iceland, Europe. Known only from the type collection.

Species delimitation in the genus *Urocystis* is based on combined characters of sizes of spore balls, spores and sterile cells, by the number of spores per spore ball, by the continuity or discontinuity of the layer of sterile cells, as well as by the host plant, usually at genus level (comp. Vánky 1994).

The collection of *Urocystis* on *Deschampsia*

Table 1. Synopsis of *Urocystis* Rabenh. *ex* Fuckel species infecting grasses from the subtribe Aveninae.

Species	Host plant(s)	Spore balls	Spores	Number of spores per spore ball	Sterile cells	References
U. avenae-elatioris (Kochman) Zundel	*Arrhenatherum elatius* (L.) P. Beauv. *ex* J. Presl & C. Presl	16–36 µm	13.0–17.5 × 10.5–14.5 µm	1–3(–4)	4–16 µm, almost completely surrounding the spores	Vánky 1994
U. avenastri (Massenot) Nannf.	*Avenula pubescens* (Huds.) Dumort.	22–35(–44) × 20–32(–40) µm	14–20(–22.5) × 12–16 µm	1–4(–5)	4–15 µm, completely surrounding the spores	Vánky 1994
U. behboudii (Esfand.) Vánky	*Arrhenatherum kotschyi* Boiss.	23–45(–50) × 17–36(–40) µm	14.5–21.5 × 13–17 µm	1–3(–4)	7–16 × 6–12 µm, completely surrounding the spores	Esfandiari & Petrak 1950; Vánky 1994
U. deschampsiae M. Piątek	*Deschampsia caespitosa* L.	(15–)20–40(–48) × 15–30(–32) µm	(12–)13–17 × 10–13(–15) µm	1–4(–6)	7–10(–13) × (5–)6–8(–9) µm, almost completely surrounding the spores	this paper
U. koeleriae L. Guo	*Koeleria litvinowii* Domin	19.5–38.5 × 15.0–30.5 µm	11.0–19.0(–20.5) × 10.0–15.0 µm	(0–)1–4(–5)	5.5–13.0 × 5.0–10.0 µm, almost completely surrounding the spores	Guo 2005
U. rostrariae M. Piątek	*Rostraria cristata* (L.) Tzvelev	(50–)60–80(–100) × (40–)50–60(–85) µm	(12–)14–18(–19) × (10–)12–15(–16) µm	(6–)10–20(–40) (or more?)	(6–)9–13 × 6–10 µm, completely surrounding the spores	Piątek 2006
U. rytzii (Massenot) J. Müller	*Avenula versicolor* (Vill.) M. Lainz	17–51 × 14–33 µm	13–18 × 11–14 µm	1–3(–5)	5–11 × 3–7 µm, almost completely surrounding the spores	Müller 1991
U. triseti (Cif.) Zundel	*Trisetum alpestre* P. Beauv., *T. flavescens* (L.) P. Beauv., *T. spicatum* (L.) K. Richt.	24–40 × 20–32 µm	13.0–18.5 × 11.0–16.0 µm	1–6	4–13 µm, completely surrounding the spores	Vánky 1994

caespitosa from Iceland described here as a new species was reported by Jørstad (1962) as *Urocystis* sp. This is the only report of *Urocystis* on the grass genus *Deschampsia* P. Beauv., which belongs to the subtribe Aveninae of the tribe Aveneae (Clayton & Renvoize 1986). The material is not abundant, represented by only one small, sterile plant. To reduce its further depletion I include more illustrations of the spores than is done usually when describing *Urocystis* species.

The grasses included in the subtribe Aveninae are infected by seven further *Urocystis* species:

U. avenae-elatioris (Kochman) Zundel, type on *Arrhenatherum elatius* (L.) P. Beauv. *ex* J. Presl & C. Presl, *U. avenastri* (Massenot) Nannf., type on *Avenula pubescens* (Huds.) Dumort., *U. behboudii* (Esfand.) Vánky, type on *Arrhenatherum kotschyi* Boiss., *U. koeleriae* L. Guo, type on *Koeleria litvinowii* Domin, *U. rostrariae* M. Piątek, type on *Rostraria cristata* (L.) Tzvelev, *U. rytzii* (Massenot) J. Müll., type on *Avenula versicolor* (Vill.) M. Lainz, and *U. triseti* (Cif.) Zundel, type on *Trisetum spicatum* (L.) K. Richt. The morphological characters, host plants and geographical distribution of these species were discussed by Piątek (2006) and are also summarized here in Table 1.

Urocystis deschampsiae superficially resembles *U. avenastri* and *U. koeleriae*, especially in respect to the number of spores per spore ball. However, *U. deschampsiae* differs from these two species by its slightly smaller spores and sterile cells, and by having different host genera. Additionally, in *U. koeleriae* a certain percentage of the spore balls are composed of sterile cells only, lacking spores. No such spore balls have been observed in *Urocystis deschampsiae*.

Urocystis deschampsiae has similar-sized spore balls and spores like *U. avenae-elatioris*. However, both of these fungi differ by the percentage of spore balls with a given number of spores. In *U. deschampsiae* these values are as follows: 1 – 30%, 2 – 42%, 3 – 17%, 4 – 9%, 5 – 1%, 6 – 1%. In *U. avenae-elatioris* the values are these: 1 – 78.5%, 2 – 17.5%, 3 – 3.5%, 4 – 0.5% (Vánky 1994).

ACKNOWLEDGEMENTS. I am grateful to Dr. Kálmán Vánky (Tübingen, Germany) for critical revision of the manuscript, to my wife Dr. Jolanta Piątek (Kraków, Poland) for her drawings, to Dr. Guðríður Gyða Eyjólfsdóttir (Akureyri, Iceland) for deciphering the collection dates on the label of the type specimen of *Urocystis deschampsiae*, to the Curators of BPI and O for the loan of smut fungi specimens, and to Anna Łatkiewicz (Kraków, Poland) for assistance with SEM micrographs, which were taken in the Laboratory of Field Emission Scanning Electron Microscopy and Microanalysis at the Institute of Geological Sciences of the Jagiellonian University, Kraków. This study was supported by the Polish Ministry of Education and Science for 2005–2008 (grant no. 2 P04G 019 28).

REFERENCES

AZBUKINA Z. M. & KARATYGIN I. V. 1995. Definitorium Fungorum Rossiae. Ordo Ustilaginales. Fasc. 2. Familia Tilletiaceae. Nauka, St. Petersburg.

BEGEROW D., LUTZ M. & OBERWINKLER F. 2002. Implications of molecular characters for the phylogeny of the genus *Entyloma*. *Mycol. Res.* **106**(12): 1392–1399.

CLAYTON W. D. & RENVOIZE S. A. 1986. Genera Graminum. Grasses of the world. *Kew Bull. Addit. Ser.* **13**: 1–389.

ESFANDIARI E. & PETRAK F. 1950. Pilze aus Iran. *Sydowia* **4**: 11–38.

GUO L. 2005. Two new species of *Urocystis* (Urocystales) from China. *Mycotaxon* **92**: 269–272.

JØRSTAD I. 1962. Icelandic parasitic fungi apart from Uredinales. *Skr. Norske Vidensk.-Akad. Oslo, Mat.-Naturvidensk. Kl.* **10**: 1–72.

JØRSTAD I. 1963. Ustilaginales of Norway (exclusive of *Cintractia* on *Carex*). *Nytt. Mag. Bot.* **10**: 85–130.

KAWECKA-STARMACHOWA B. 1939. Brandpilze Polens. 2. Teil. Tilletineae. *Spraw Komis. Fizjogr.* **73**: 147–224 + tabs i–iv (preprint, in Polish with German summary).

KOKEŠ P. & MÜLLER J. 2004. Checklist of downy mildews, rusts and smuts of Moravia and Silesia. *Czech Mycology* **56**: 121–148.

LIRO J. I. 1938. Die Ustilagineen Finnlands. II. *Ann. Acad. Sci. Fenn., Ser. A* **42**(1): 1–720.

LUTZ M., GÖKER M., PIĄTEK M., KEMLER M., BEGEROW D. & OBERWINKLER F. 2005. Anther smuts of Caryophyllaceae: molecular characters indicate host-dependent species delimitation. *Mycol. Progr.* **4**(3): 225–238.

MÜLLER J. 1991. *Urocystis rytzii* (Massenot) Müller – ein neuer Brandpilz für die Karpaten. *Česká Mykol.* **45**(3): 69–74.

PIĄTEK M. 2002. Nomenclatural and taxonomical notes on the smut fungi described by Bolesława Kawecka-Starmachowa. *Polish Bot. J.* **47**(2): 223–226.

PIĄTEK M. 2006. *Urocystis rostrariae*, a new species of smut fungus on *Rostraria* from Jordan. *Mycotaxon* **97**: 119–124.

SPOONER B. 2000. An *Entyloma* (Ustilaginales) on *Crepis capillaris* in Britain. *Mycologist* **14**(2): 188.

TROTTER A. 1908. Un nuovo parassita ipogeo del gen. *Entyloma*. *Ann. Mycol.* **6**: 19–22.

VÁNKY K. 1985. Carpathian Ustilaginales. *Symb. Bot. Upsal.* **44**(2): 1–309.

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

VÁNKY K. 1994. European smut fungi. G. Fischer Verlag, Stuttgart – Jena – New York.

VÁNKY K. 1998. Taxonomical studies on Ustilaginales. XVIII. *Mycotaxon* **69**: 93–115.

VÁNKY K. 2005. Taxonomic studies on Ustilaginomycetes – 25. *Mycotaxon* **91**: 217–272.

VÁNKY K. & BERNER D. 2003. *Microbotryum silybium* sp. nov. (Microbotryales). *Mycotaxon* **85**: 307–311.

VÁNKY K. & MCKENZIE E. H. C. 2002. Two new species of Ustilaginomycetes from New Zealand. *New Zealand J. Bot.* **40**: 117–121.

VÁNKY K. & SCHOLZ H. 2001. Three new species of smut fungi (Ustilaginomycetes). *Nova Hedwigia* **72**: 391–398.

VÁNKY K., HORITA H. & JAGE H. 2005. *Entyloma cosmi* sp. nov. on *Cosmos bipinnatus* (Compositae). *Mycoscience* **46**(6): 364–366.

ZUNDEL G. L. 1953. The Ustilaginales of the world. *Pennsylvania State Coll. School Agric. Dept. Bot. Contr.* **176**: xi + 1–410.

Received 17 February 2006