New records of Bulgarian smut fungi (Ustilaginales)

C. M. Denčev

Institute of Botany with Botanical Garden, Bulgarian Academy of Sciences, Sofia 1113, Bulgaria

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Entorrhiza casparyana, Entyloma corydalis, E. urocystoides, Sporisorium schweinfurthianum, Urocystis eranthidis, U. ficariae, U. ornithogali, U. primulicola, U. ranunculi, Ustilago bosniaca, U. thlaspeos, as well as sixteen fungus-host combinations in the Ustilaginales are reported as new to Bulgaria. Some previously published Bulgarian smut specimens are revised.

Keywords: Ustilaginales, taxonomy, fungus list.

Field investigations and revision of specimens in the Mycological Herbarium, (SOM) and of type material from BPI have yielded 11 species and 16 fungus-host combinations new to Bulgaria.

Measurements of teliospores are given in the form (smallest observed-) mean ± standard error (-largest observed); except otherwise stated, 100 teliospores have been measured in each collection.

Species previously unrecorded in Bulgaria

1. *Entorrhiza casparyana* (Magnus) Lagerh. – Hedwigia 27: 262. 1888.

Sori in the roots, forming galls, ovoid or elongated, often branched, up to 15 mm long, dark brown. – Teliospores globose or subglobose, (13-) 17.9 ± 0.3 (-28) x (12.5-) 17.1 ± 0.3 (-25.5) µm, whitish to light yellow; wall two-layered, the inner layer 0.5 – 1.5 µm thick, the outer layer variable in thickness (0.5 – 10 µm, including the ornamentations) and ornamentation (tuberculose or verrucose, seldom smooth).

Specimen examined.- On *Juncus thomasii* Ten. (new host): Rila Mt., ca. 1700 m elevation, 12.VII.1983, K. Vánky, SOM 19754-M.

2. *Entyloma corydalis* De Bary. – Bot. Zeitung (Berlin) 32: 104. 1874.

Sori in the leaves, forming round, ovate or broadly elliptical, flat spots, 2 – 4 mm long, at first whitish, later grayish-brown or

greenish-brown. – Teliospores single or sometimes in pairs or small groups, broadly ellipsoidal to ellipsoidal, globose, subglobose, ovoid or slightly irregular, (10.5-) 14.4 ± 0.2 (-20.5) x (10-) 12.0 ± 0.1 (-15) µm, light yellow to yellowish-brown; wall ca. 1 µm thick, the exospore verrucose to smooth.

Specimen examined. — On *Corydalis bulbosa* (L.) DC.: Black sea coast, near Sinemorec, Seleštarski dol, 26.IV.1980, V. Čalákov (sub *Corydalis cava* (L.) Schweigg. & Koerte), SOM 15197-M.

3. *Entyloma urocystoides* Bubák. – Arch. Přír. Vyzk. Čech. 15(3): 50. 1912.

Sori in the leaves, forming round or elliptical, swollen spots, 1 – 4 mm long, at first whitish, later yellowish-brown. – Teliospores single, in general outline suborbicular, oval or broadly elliptical, (15-) 18.4 ± 0.2 (-24) x (12.5-) 15.9 ± 0.1 (-19) µm, pale yellow to light yellowish-brown; wall two-layered, the inner layer thin (0.5 – 0.8 µm), the outer layer irregularly thick, when mature with very large, polyhedral, often irregular thickenings [(1.5-) 2.5 – 6 µm high].

Specimen examined.- On *Corydalis bulbosa* (L.) DC.: Black sea coast, near Sinemorec, Seleštarski dol, 26.IV.1980, V. Čalákov (sub *Corydalis cava*), SOM 15197-M (mixed with *E. corydalis).*

4. *Sporisorium schweinfurthianum* (Thüm.) Vánky. – Publ. Herb. Univ. Uppsala 11: 12. 1983.

Sori in the ovaries, at first hidden by the glumes and covered by a grayish-brown peridium; spore mass semiagglutinated, dark brown to black; central columella well-developed, single. – Sterile cells in irregular groups, singly or catenate, subglobose, broadly ellipsoidal, ovoid or with flattened contact sides, 8 – 12 x 6 – 10 µm, hyaline, thin-walled. – Teliospores at first in spore balls, when mature single, subglobose, ovoid or broadly ellipsoidal, (10-) 11.9 ± 0.1 (-15) x (9-) 10.6 ± 0.1 (-12.5) µm, light reddish-brown; wall ca. 0.5 µm thick, the exospore minutely verrucose.

Specimens examined. – On *Imperata cylindrica* (L.) Beauv.: Black sea coast, near Sinemorec, 22.VIII.1988, I. Apostolova, SOM 19721-M; — Struma Valley, near Kulata, Kartaleca, 9.VI.1987, S. Kožuharov, SOM 19722-M.

5. *Urocystis eranthidis* (Pass.) Ainsw. & Samps. – The British Smut Fungi: 96. 1950.

Sori in the leaves, petioles and stems as blister-like swellings, variable in size, at first lead-coloured, covered by the epidermis, which later ruptures exposing the powdery, dark brown to black

spore mass. – Spore balls globose, ovoid, broadly ellipsoidal to ellipsoidal or irregular, composed of 1 – 2 (-3) teliospores (1 = 79%, 2 = 18%, 3 = 3%) and almost continuous to completely continuous layer of peripheral, sterile cells; 18 – 33 x 17 – 30 µm (with 1 teliospore), 27 – 50 x 21 – 34 µm (with 2 teliospores). – Sterile cells in general outline orbicular to elliptical or irregular, 6.5 – 14 x 5 – 10.4 µm, light yellow; wall 1 – 1.5 µm thick, smooth. – Teliospores globose, subglobose, broadly ellipsoidal or ovoid, (14-) 17.5 ± 0.1 (-20.5) x (13-) 15.8 ± 0.1 (-19) µm, reddish-brown, with very finely granular content; wall 2 – 2.5 µm thick, the exospore smooth.

Specimen examined.- On *Eranthis hyemalis* (L.) SALISB. (hort.): Sofia region, Sofia, Bot. Garden, 20.IV.1941, A. RADOSLAVOV [sub *U. anemones* (PERS.) ROSTR.], SOM 11164-M.

6. *Urocystis ficariae* (LIRO) MOESZ. – Budapest és környékének gombái: 137. 1942.

Sori in the leaves and petioles as blister-like swellings, elliptical or elongated, variable in size, at first grey, covered by the epidermis, which later ruptures exposing the powdery, black spore mass. – Spore balls globose to ellipsoidal or irregular, composed of 1 – 2 (-5) teliospores (1 = 66%, 2 = 29%, 3 = 4%, 4 = 0.7%, 5 = 0.3%) and a peripheral discontinuous to almost continuous layer of sterile cells; 16 – 28 x 13 – 26 µm (with 1 teliospore), 20 – 43 x 16 – 31 µm (with 2 teliospores). – Sterile cells in general outline orbicular to broadly elliptical or irregular, 6.5- 13 x 5 – 8 µm, light yellowish-brown; wall 1 – 1.5 µm thick, smooth. – Teliospores globose, subglobose or broadly ellipsoidal, (13-) 16.7± 0.1 (-20.5) x (10.5-) 14.7 ± 0.2 (-18) µm, dark reddish-brown, with granular content; wall 1.5 – 2 µm thick, the exospore smooth.

Specimen examined.- On *Ranunculus ficaria* L.: Sofia region, Sofia, Bojana, 5.VI.1980, ČALÂKOV, SOM 15192-M.

7. *Urocystis ornithogali* KÖRN. – Ann. Sci. Nat. Bot. 4: 240. 1877.

Sori in the leaves as elliptical swellings, 4 – 10 mm long, at first covered by the epidermis, which later ruptures exposing the powdery, black spore mass. – Spore balls globose, subglobose, broadly ellipsoidal or ovoid, composed of 1 – 3 (-5) teliospores (1 = 49%, 2 = 39%, 3 = 9.5%, 4 = 1.7%, 5 = 0.8%), completely surrounded by sterile cells; 17 – 29 x 16 – 26 µm (with 1 teliospore), 22 – 36 x 16 – 31 µm (with 2 teliospores). – Sterile cells in general outline orbicular, suborbicular, oval, broadly elliptical or irregular, 4 – 12.5 x 4 – 8 µm, yellowish-brown; wall 1 – 1.5 (-2) µm thick, smooth. – Telio-

spores broadly ellipsoidal to ellipsoidal, subglobose or ovoid, (13-) 16.6 ± 0.1 (-20.5) x (10.5-) 13.6 ± 0.1 (-16.5) µm, dark reddish-brown; wall ca 1.5 µm thick, the exospore smooth.

Specimen examined.- On *Gagea bohemica* (ZAUSCHN.) SCHULT. & SCHULT. FIL.: Belasica Mt., above Petrič, 28.III.1963, C. HINKOVA, SOM 8726-M.

8. *Urocystis primulicola* MAGNUS. – Verh. Bot. Vereins Prov. Brandenburg (Sitzb.) 20: 53. 1878.

Sori in the ovaries, the capsules filled with granular-powdery, black spore mass. – Spore balls variable in shape and size, broadly ellipsoidal, ovoid or irregular, 26 – 115 x 24 – 63 µm, composed of (1 –) 3 – 15 (-20) teliospores, completely surrounded by sterile cells. – Sterile cells in general outline broadly elliptical, orbicular, suborbicular, oval or irregular, 6 – 19 x 5 – 15 µm, yellowish-brown; wall 1—2.5 µm thick, smooth. – Teliospores broadly ellipsoidal to ellipsoidal, globose, subglobose or ovoid, often irregularly elongated, (11-) 14.2 ± 0.1 (-18) x (9-) 11.4 ± 0.1 (-14) µm, dark reddish-brown; wall 1 – 1.5 µm thick, the exospore smooth.

Specimen examined. – On *Primula veris* L. ssp. *columnae* (TEN.) LÜDI: Pirin Mt., Malkija Kazan, ca 2300 m elevation, Sept. 1987, M. ANČEV, SOM 19590-M.

9. *Urocystis ranunculi* (LIBERT) MOESZ, A Kárpát-medence üszöggombái: 213. 1950.

Sori in the leaves, petioles, stems, pedicels, sometimes also in the sepals, forming elongated (up to 2.5 cm) swellings, at first covered by the epidermis, which later ruptures exposing the powdery, black spore mass. – Spore balls variable in shape, composed of 1 – 2 (-4) teliospores (1 = 68%, 2 = 26%, 3 = 4.6%, 4 = 1.4%) and a discontinuous peripheral layer of sterile cells (1 – 14); sterile cells sometimes lacking. – Sterile cells in general outline broadly to narrowly elliptical, orbicular, suborbicular, oval, or irregular, 6.5 – 16.5 x 5 – 13 µm, pale yellowish-brown; wall smooth. – Teliospores broadly ellipsoidal to ellipsoidal, globose, subglobose, ovoid, or irregular (13-) 17.2 ± 0.2 (-24) x (10-) 13.2 ± 0.1 (-16.5) µm, brown, with a finely granular content; the exospore smooth.

Specimen examined. - On *Ranunculus repens* L.: North-eastern Bulgaria, near Nikolovo, Lipnik, 26.V.1986, C. DENČEV, SOM 19593-M.

10. *Ustilago bosniaca* BECK. – Ann. K.-K. Naturhist. Hofmus. 9: 121. 1894.

Sori in the inflorescences (pedicels and flowers) and in the leaves forming irregular, conspicuously galliform swellings, at first

covered by a peridium that ruptures irregularly to expose the powdery, dark violet spore mass. – Teliospores variable in shape, mostly broadly ellipsoidal, subglobose or ovoid, rarely pyriform, ellipsoidal or irregularly elongated (11.5-) 14 ± 0.1 (-18) x (9-) 11.9 ± 0.1 (-15.5) µm, some elongated spores up to 24.5 µm long, brownish-violet; the exospore reticulate-verrucose or minutely verrucose.

Specimen examined. – On *Pleuropteropyrum undulatum* (A. Murr.) A. Löve & D. Löve: Pirin Mt., below Peak Vihren, 2000 m elevation, 26.IX.1986, C. Denčev, SOM 18890-M.

11. *Ustilago thlaspeos* (Beck) Lagerh. – in Sydow, Ust. no. 118. 1897.

Sori destroying the seeds and filling the fruits with powdery, light brown spore mass, inconspicuous until the siliquae open. – Teliospores broadly ellipsoidal, globose, subglobose, ovoid or irregular (10-) 13.3 ± 0.1 (-20.5) x (8-) 11.5 ± 0.05 (-14.5) µm (N = 500), pale to light yellowish brown; wall ca 0.5 µm thick (without ornaments), the exospore verrucose, warts 0.5 – 1 µm high, on one side of the teliospore wing-shaped and elongated, with the wing up to 2.5 µm high.

Specimens examined. – On *Alyssum reiseri* Vel. (new host): Znepole region, near Cărven-Dol, 950 m elevation, M. Ančev, 20. VII. 1987, SOM 19481-M. — same host and station, 22. VIII. 1979, SOM 19484-M. — same host and station, 12.VII.1980, SOM 19485-M. – On *Erysimum diffusum* Ehrh. (new host): Znepole region, Zemenska Mt., near Zlogoš, 7.V.1986, M. Ančev, SOM 19482-M. – On *E. weltschevi* Urum. (new host): North-eastern Bulgaria, above Draganovo, ca 200 m elevation, 5.VIII.1986, C. Denčev, SOM 19483-M.

Tab. 1. — Morphometrical variability of the teliospores of *Ustilago thlaspeos* (Beck) Lagerh.

Host, specimen	Length	Width
Arabis hirsuta (L.) Scop. Vánky, Ust. 96, Roumania (orig.)	(10-) 13.2 ± 0.1 (-19.5)	(8-) 11.0 ± 0.1 (-14.5)
Alyssum reiseri Vel. SOM 19481-M	(12-) 13.9 ± 0.1 (-18.5)	(10-) 12.1 ± 0.1 (-14.5)
Alyssum reiseri Vel. SOM 19484-M	(11-) 13.1 ± 0.1 (-17.5)	(9-) 11.7 ± 0.1 (-14.5)
Alyssum reiseri Vel. SOM 19485-M	(11.5-) 13.2 ± 0.1 (-18.5)	(9-) 11.4 ± 0.1 (-14.5)
Erysinum diffusum Ehrh. SOM 19482-M	(10-) 13.4 ± 0.2 (-20.5)	(9-) 11.2 ± 0.1 (-14.5)
E. weltschevi Urum. SOM 19483-M	(10-) 13.3 ± 0.2 (-18.5)	(8-) 10.9 ± 0.1 (-13.5)
in Lindeberg (1959)[1]	10 – 19	9 – 14
in Vánky (1985)[2]	11 – 18	10 – 16

[1] on *Arabis hirsuta* (L.) Scop., *Draba incana* L. and *Cardamine bellidifolia* L.
[2] on *Arabis hirsuta* (L.) Scop., *Draba aizoides* L. and *Thlaspi alpestre* L.

The genera *Alyssum* L. and *Erysimum* L. are new hosts for *Ustilago thlaspeos*. Four species have been described to be parasitic in seeds of Brassicaceae. LINDEBERG (1959), however, has synonymized *U. seminum* JUEL, *U. arabidis-alpinae* LIRO, and *U. cardamines* LIRO under the oldest name *U. thlaspeos* because of the lack of clear discontinuity in the morphology of their teliospores. My investigations of five Bulgarian specimens from three different hosts and of one Rumanian specimen (Tab. 1) show continuous morphometric variability in teliospore length and width that are in the range reported by LINDEBERG (1959). In addition, the main qualitative characters such as structure and localization of the sori and ornamentation of the exospore are similar in specimens from all hosts, thus confirming LINDEBERG's (1959) species concept.

Species with new hosts in Bulgaria

1. *Microbotryum violaceum* (PERS.) G. DEML & OBERWINKLER

Sori in the anthers of *Silene alba* (MILL.) E. KRAUSE, Thracian Plain, between Gorno Brjastovo and the Ajda Rest Home, 25.VI.1977, P. ROHOV; SOM 19752-M.

2. *Schizonella melanogramma* (DC.) SCHRÖT.

Sori in the leaves of *Carex brevicollis* DC., Predbalkan, near Salaš, 990 m elevation, 2.VI.1965, D. JORDANOV, SOM 19502-M. Teliospores (8-) 9.9 ± 0.1 (-14) x (5-) 7.2 ± 0.1 (-10) µm. — Sori in the leaves of *C. halleriana* ASSO, Stara planina Mt., near Beledie Han, 19.V.1961, C. HINKOVA; SOM 8849-M. — Sori in the leaves of *C. michelii* HOST, Znepole region, Zemenska planina Mt., near Sušica, 7.V.1986, C. DENČEV, SOM 19501-M. Teliospores (7.5-) 9.4 ± 0.1 (-12.5) x (5-) 7.1 ± 0.1 (-9) µm (N = 75).

3. *Tilletia bromi* (BROCKM.) BROCKM.

Sori in the ovaries of *Bromus japonicus* THUNB., Thracian Plain, near Sadovo, 1902, V. STRABARNY, sub *Bromus arvensis* L., BUBÁK (1903); BPI 173207. Teliospores (19.5-) 22.0 ± 0.2 (-28.5) x (18-) 20.6 ± 0.1 (-24) µm. The specimen is the holotype of *Tilletia velenovskyi* BUBÁK, a taxonomical synonym of *T. bromi*. *Bromus arvensis* is not a host for this species in Bulgaria.

4. *Urocystis magica* PAS.

Sori in the leaves of *Allium scorodoprasum* L., Thracian Plain, near Plovdiv, 17.V.1980, V. ČALÁKOV, sub *Urocystis allii* Schellenb., SOM 15193-M. Sterile cells 5.5 – 12.5 x 4 – 9 µm. Teliospores (12-) 15.3 ± 0.1 (-19.5) x (10-) 12.8 ± 0.1 (-15.5) µm.

5. *U. miyabeana* TOGASHI & ONUMA

Sori in the leaves of *Polygonatum latifolium* (JACQ.) DESF., Thracian Plain, near Plovdiv, Ostrova, 11.V.1962, C. HINKOVA; sub *U. polygonati* (LAVROV) ZUNDEL, SOM 8725-M. Sterile cells 5 – 14 x 3.5 – 7.5 µm. Teliospores (12.5-) 14.8 ± 0.1 (-18) x (10.5-) 13.1 ± 0.1 (-16.5) µm.

6. *U. muscaridis* (NIESSL) MOESZ

Sori in the leaves of *Muscari racemosum* (L.) MILL., Predbalkan, near Belogradčik, 10.XI.1961, C. HINKOVA, SOM 2520-M. Sterile cells 5 – 12.5 x 3.5 – 9 µm. Teliospores (13-) 15.9 ± 0.1 (-19.5) x (10-) 13.4 ± 0.1 (-16.5) µm.

7. *Ustilago bullata* BERK.

Sori in the ovaries and basal parts of the glumes of *Bromus sterilis* L., Tundža hilly region, near Välča Poljana, 6.VI.1986, C. DENČEV, SOM 19095-M. Teliospores (6.5-) 7.8 ± 0.1 (-10) x (5.5-) 6.8 ± 0.05 (-8) µm.

8. *U. hypodytes* (SCHLECHT.) FR.

Sori in the culms of *Stipa pennata* L. (Sens. lat.), Slavjanka Mt., above Paril, Kojnara, 2.VII.1958, C. HINKOVA, sub *U. williamsii* (GRIFFITHS) LAVROV; SOM 15201-M. Teliospores (4-) 5.4 ± 0.1 (-6.5) x (3.5-) 4.7 ± 0.1 (-6.5) µm.

9. *U. major* SCHRÖT.

Sori in the flowers of *Silene roemeri* FRIV. (new host), Stara planina Mt., above Karlovo, 17.VI.1927, I. URUMOV [sub *U. violacea* (PERS.) ROUSSEL], SOM 5758-M. Teliospores (6.5-) 9.3 ± 0.1 (-14) x (6.5-) 8.0 ± 0.1 (-10) µm.

10. *U. ornithogali* (SCHUM. & KUNZE) MAGNUS

Sori in the leaves of *Gagea bohemica* (ZAUSCHN.) SCHULT. & SCHULT. FIL., Pirin Mt., above Sandanski, 680 m elevation, 30.III.1980, V. ČALÅKOV, SOM 15184-M. Teliospores (12-) 14.9 ± 0.2 (-23.5) x (9-) 10.9 ± 0.1 (-13.5) µm . – Sori in the leaves of *G. fistulosa* (RAM.) KER-GAW., Rila Mt., below Peak Čengene-Čal, 2200 m elevation , above the Zavračica Rest Home, 21.VI.1962, C. HINKOVA, SOM 11304-M. – Sori in the leaves of *G. pratensis* (PERS.) DUM., Stara planina Mt., near Gabrovo, 20.III.1897, I. NEJČEV, SOM 9998-M. Teliospores (11-) 14.8 ± 0.2 (-23.5) x (9-) 11.4 ± 0.1 (-15.5) µm.

Species of revised specimens published from Bulgaria

1. *Microbotryum violaceum* (PERS.) G. DEML & OBERW., sub *Ustilago violacea* (PERS.) ROUSSEL (KLIKA, 1926; KREISEL, 1959).
2. *Sporisorium destruens* (SCHLECHT.) VÁNKY, sub *Ustilago panici-miliacei* (PERS.) WINT. (RADOSLAVOV, 1923).
3. *S. holci-sorghi* (RIV.) VÁNKY, sub *Sorosporium reilianum* (KÜHN) MCALPINE (MARKOV, 1961; 1964).
4. *S. neglectum* (NIESSL) VÁNKY, sub *Ustilago panici-glauci* (WALLR.) WINT.(ATANASOV & al ., 1931).
5. *S. sorghi* EHRENB. ex LINK, sub *Sphacelotheca sorghi* (LINK) CLINT.(MARKOV, 1961; 1964).
6. *Ustilago heufleri* FUCKEL, sub *U. tulipae* (RABENH.) WINT. (HINKOVA, 1961).

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