

Taxonomical studies on ovariicolous smut fungi on *Caryophyllaceae*. II. *Haradaea alsineae*

Cvetomir M. Denchev

Institute of Botany, Bulgarian Academy of Sciences, 23 Acad. G. Bonchev St., Sofia 1113, Bulgaria (e-mail: cmdenchev@yahoo.co.uk)

Received 10 July 2007 / Accepted 28 July 2007

Abstract. A revision of *Haradaea alsineae* on *Stellaria nitens* was carried out. A description and illustrations of this species are presented.

Key words: *Caryophyllaceae*, *Haradaea*, *Microbotryum*, smut fungi, *Stellaria*, U.S.A., *Ustilago*

Introduction

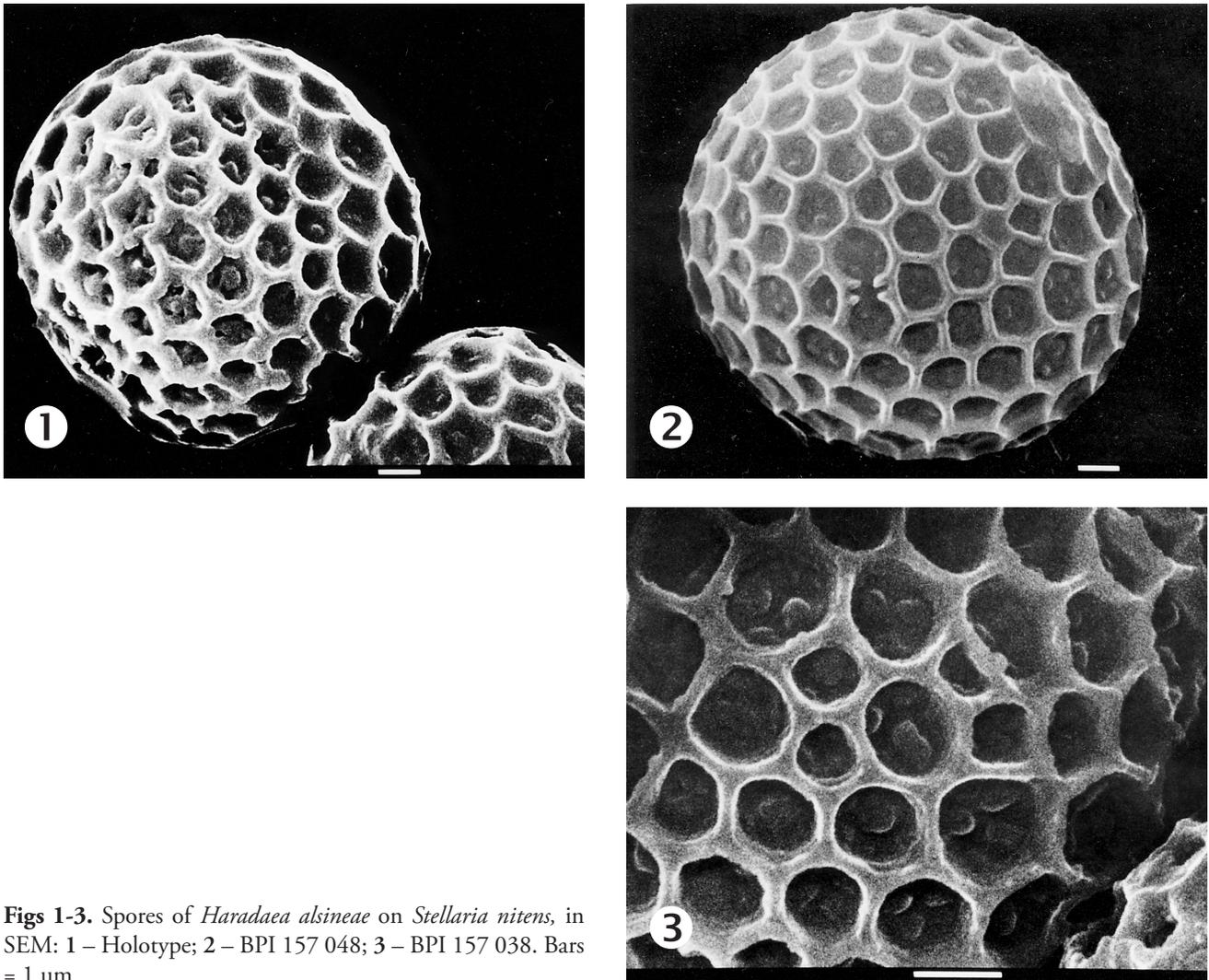
It has been recently proposed that the genus *Microbotryum* should be restricted to anthericolous species (including species that destroy both anthers and ovaries, namely *M. majus* (J. Schröt.) G. Deml & Oberw. and *M. savilei* Denchev) on *Caryophyllaceae* (Almaraz *et al.* 2002; Denchev 2006; Denchev *et al.* 2006, 2007), while the ovariicolous smut fungi on *Caryophyllaceae* have been separated in the genus *Haradaea* (Denchev *et al.* 2006, 2007). Taxonomic revisions of *Haradaea jehudana* (Zundel emend. Denchev) Denchev & H.D. Shin and *H. moenchiae-manticae* (Lindtner) Denchev & H.D. Shin (both as *Bauhinus jehudanus*), and *H. moehringiae* (Togashi & Y. Maki) Denchev have been presented in Denchev (1997) and Denchev *et al.* (2007), respectively. Results from a study on *H. alsineae* are presented here.

Clinton & Zundel (in Zundel 1939: 1029) described *Ustilago alsineae* from the ovaries of *Stellaria nitens* and *S. praecox*. Additional descriptions of this species are available in Zundel (1953), Fischer (1953), Karatygin & Azbukina (1989), and Piątek (2005) (in all of these, the diagnosis page

is incorrectly cited as '991'). However the descriptions in the abovementioned references do not correlate in some details with data obtained during the present examination. In order to compare and distinguish *Haradaea alsineae* from other members of *Haradaea*, a description of this species is also provided.

Materials and Methods

The available specimens, kept in BPI as *Ustilago alsineae*, were investigated by light microscopy (LM) and by scanning electron microscopy (SEM). For observations in LM, the spores were mounted in lactophenol solution on glass slides, gently heated to boiling point and then cooled. The measurements of spores are given in the form: min-max (mean \pm 1 standard deviation). In the description, the symbol 'n/x=' is used to indicate the total numbers of measured collections and spores, respectively. For studies in SEM, the spores were attached to specimen holders by double-sided adhesive tape, coated with gold, and the surface structure observed at 15 kV.



Figs 1-3. Spores of *Haradaea alsineae* on *Stellaria nitens*, in SEM: 1 – Holotype; 2 – BPI 157 048; 3 – BPI 157 038. Bars = 1 µm

The spore mass and spore colour treatments are based on Rayner's colour chart (Rayner 1970; explanations in Stearn 1998: 233-235). As we have previously noted (Denchev 1997: 326), the colours of the spore wall and its ornaments are difficult to name: the colour under a low LM magnification (e.g., 125×) differs from that under a high LM magnification ($\geq 800\times$). Under a low magnification, it is possible to evaluate only generally the spore colour while under a high magnification, the colours of the muri and the bottom of the meshes can be characterized.

Taxonomy

Haradaea alsineae (G.P. Clinton & Zundel) Denchev & H.D. Shin, Mycol. Balcan. 3: 72, 2006. — *Ustilago alsineae* G.P. Clinton & Zundel in Zundel, North American Flora 7(14): 1029, 1939. — *Microbotryum alsines* (G.P. Clinton & Zundel) M. Piątek, Polish Bot. J. 50: 7, 2005. **Figs 1-3**

Sori ovoid or ellipsoidal, about 2-3 mm in length, destroying the ovules and filling the capsules with powdery

spore mass in place of the seeds; inconspicuous. Infection systemic. **Spore mass** violaceous black (*violaceo-niger*) or violet slate (*violaceo-ardesiacus*). **Spores** subglobose, globose or broadly ellipsoidal, 10-15.5 × 9-14 (12.4±0.9 × 11.5±0.9) µm (n/5=350), length/width ratio 1.04-1.14 (mean 1.08); spore wall reticulate, under a low LM magnification (120×) vinaceous purple (*vinoso-purpureus*), livid purple (*livido-purpureus*) or livid violet (*livido-violaceus*), under a high LM magnification (800×) muri livid violet, dark violet (*atroviolaceus*) or greyish violet (*griseo-violaceus*), bottom of the meshes hazel (*avellaneus*) or isabelline (*isabellinus*), 8-10 (-11) meshes per spore diameter, meshes irregularly or regularly (penta-) hexagonal, (0.8-) 1.2-1.6 (-2.4) µm long, 0.8-1.2 (-1.4) µm high; basal part of the muri and bottom of the meshes with 3-7, coarse, partly confluent club-shaped ornaments or at the bottom with non-confluent verrucae.

Hosts: on *Stellaria* (*Alsinoideae*, *Caryophyllaceae*): *S. nitens* Nutt. (*Alsine nitens* (Nutt.) Greene, *Stellaria praecox* A. Nels.).

Distribution: North America (U.S.A.).

Specimens examined (all deposited at BPI as *Ustilago alsinea*):

On *Stellaria nitens*: U.S.A.: Idaho, Canyon Co., Falk's Store, 22 Apr 1911, A. Nelson (BPI 157 050, Holotype; host as *Alsine praecox*)⁽¹⁾; Washington, Whitman Co., SE of Pullman, near Whitlow Station, 1 May 1926, G.L. Zundel & E.E. Stoney (BPI 157 047)⁽²⁾; Washington, Whitman Co., Pullman, W of Washington State College Campus, 29 Apr 1926, G.L. Zundel (BPI 157 041 –⁽³⁾; 157 044); ditto, 5 May 1926, G.L. Zundel (BPI 157 037; 157 043; 157 049 –⁽⁴⁾); ditto, Washington State College Campus, 9 May 1925, G.L. Zundel (BPI 157 039)⁽⁵⁾, 15 May 1920, G.L. Zundel (BPI 157 038; 157 042; 157 046 –⁽⁶⁾); Washington, Stevens Co., 1 mi. S of Addy, 19 May 1926, G.L. Zundel (BPI 157 040; 157 045; 157 048 –⁽⁷⁾).

Colours of the spore mass and spores and spore morphometric variability

- (1) spore mass violaceous black; spores at 125× livid purple or vinaceous purple; at 800× – muri livid violet, bottom of the meshes hazel; spores 10-13 × 10-11.5 (11.5±0.6 × 10.8±0.6) µm, L/w = 1.06;
- (2) spore mass violaceous black; spores at 125× vinaceous purple; at 800× – muri livid violet, bottom of the meshes hazel; spores 10-15 × 9-13 (12.3±1.0 × 11.4±0.9) µm, L/w = 1.08;
- (3) spore mass violet slate or violaceous black; spores at 125× vinaceous purple or livid violet; at 800× – muri livid violet or greyish violet, bottom of the meshes hazel or isabelline; spores 10.5-15 × 10-13 (12.6±0.9 × 11.7±0.9) µm, L/w = 1.08;
- (4) spore mass violet slate; spores at 125× vinaceous purple or livid violet; at 800× – muri livid violet or dark violet, bottom of the meshes hazel; spores 10-15.5 × 10-14 (12.6±1.2 × 11.6±1.1) µm, L/w = 1.09;
- (5) spore mass violaceous black; spores at 125× vinaceous purple; at 800× – muri livid violet, bottom of the meshes hazel; spores 10.5-14 × 10-12.5 (12.1±0.8 × 11.6±0.7) µm, L/w = 1.04;
- (6) spore mass violet slate; spores at 125× vinaceous purple; at 800× – muri livid violet, bottom of the meshes hazel; spores 10.5-15 × 10-14 (12.4±0.9 × 11.5±0.9) µm, L/w = 1.08;
- (7) spore mass violaceous black; spores at 125× vinaceous purple; at 800× – muri dark violet or livid violet, bottom of the meshes hazel or isabelline; spores 10.5-15.5 × 9-13 (13.2±1.1 × 11.6±1.0) µm, L/w = 1.14.

Acknowledgements. The author gratefully acknowledges Dr Royall T. Moore (University of Ulster, Coleraine, Northern Ireland, UK) and Dr Roger G. Shivas (Queensland Department of Primary Industries and Fisheries, Australia) for critically reading the manuscript and helpful suggestions; Director and Curator of BPI for loan of studied specimens.

References

- Almaraz, T., Roux, Ch., Maumont, S. & Durrieu, G. 2002. Phylogenetic relationships among smut fungi parasitizing dicotyledons based on ITS sequence analysis. – *Mycological Research* **106**: 541-548.
- Denchev, C.M. 1997. Taxonomical studies on ovariicolous ustomycetes on *Caryophyllaceae*. I. *Ustilago jehudana* and *U. moenchiae-manticae*. – *Mycoscience* **38**: 323-328.
- Denchev, C.M. 2006. *Haradaca afromontana*, comb. nov. (*Microbotryaceae*). – *Mycologia Balcanica* **3**: 216.
- Denchev, C.M., Moore, R.T. & Shin, H.D. 2006. A reappraisal of the genus *Bauhinus* (*Microbotryaceae*). – *Mycologia Balcanica* **3**: 71-75.
- Denchev, C.M., Kakishima, M., Shin, H.D. & Lee, S.K. 2007. Notes on some Japanese smut fungi. III. *Ustilago moebringiae*. – *Mycotaxon* **98**[2006]: 181-184.
- Fischer, G.W. 1953. Manual of the North American smut fungi. Ronald Press Co., New York.
- Karatygin, I.V. & Azbukina, Z.M. 1989. [Order *Ustilaginales*]. – In: N.S. Golubkova [ed.]. [Guide to the fungi of USSR]. Fasc. 2. Pp. 1-220. Nauka, Leningrad. (In Russian)
- Piątek, M. 2005. Taxonomic position of the smut fungus *Ustilago alsines*. – *Polish Botanical Journal* **50**: 7-10.
- Rayner, R.W. 1970. A mycological colour chart. CMI, Surrey and the British Mycological Society, Kew.
- Stearn, W.T. 1998. Botanical Latin. 4th edn. Timber Press, Portland, Oregon, U.S.A.
- Zundel, G.L. 1939. Additions and corrections to *Ustilaginales*. – *North American Flora* **7**(14): 971-1045.
- Zundel, G.L. 1953. The *Ustilaginales* of the World. – Pennsylvania State College, School of Agriculture, Department of Botany, Contribution **176**: I-XI + 1-410.