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Bauerago vuyckii (*Microbotryaceae*) and *Moreaua kochiana* (*Anthracoideaceae*) – new records from Austria

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Abstract. Two smut fungi, *Bauerago vuyckii* on *Luzula alpina* and *Moreaua kochiana* on *Schoenus nigricans* and *Schoenus* ×*scheuchzeri,* are reported for the first time from Austria. *Luzula alpina* is a new host association for *Bauerago vuyckii.* Descriptions and illustrations are provided for these taxa.

Key words: Austria, *Bauerago vuyckii, Cyperaceae, Juncaceae, Luzula alpina, Moreaua kochiana, Schoenus nigricans,* smut fungi, taxonomy

Introduction

During visits to the herbaria at the Natural History Museum of Denmark, University of Copenhagen (C; herbarium codes according to Thiers 2020+), Institute of Biology, University of Graz (GZU), the Royal Botanic Garden, Madrid (MA), and the Natural History Museum Vienna (W), that were carried out by two of the authors (TTD and CMD), two smut fungi, *Bauerago vuyckii* and *Moreaua kochiana,* were found as new for Austria.

Bauerago is a small genus in the *Microbotryales* comprising nine species on host plants belonging to three, monocotyledonous families, namely, *Commelinaceae* (*Commelina* and *Tinantia*), *Cyperaceae* (*Cyperus*), and *Juncaceae* (*Juncus* and *Luzula*). Their sori destroy ovules

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of infected plants, filling the capsules (achenes, in the cases of host plants in *Cyperus*) with spores. The sori lack peridia and columellae, and there are no sterile cells between the spores (Vánky 2013; Denchev & Denchev 2018).

Moreaua belongs to the *Anthracoideaceae* family. The sori are developed in flowers and form a naked, black, granular-powdery mass of spore balls on the surface of filaments and/or ovaria (in some species also filling aborted and deformed nuts) that are completely hidden by adjacent glumes. Columella, peridium, and sterile cells are lacking. Spore balls are composed of rather firmly cohering spores (Denchev & Denchev 2014). *Moreaua* comprises 38 species, known mostly from the Southern Hemisphere (33 species), with only seven recorded from the Northern Hemisphere. All species are parasites on host plants in *Cyperaceae* (Vánky 2013; Denchev & Denchev 2014).

Material and methods

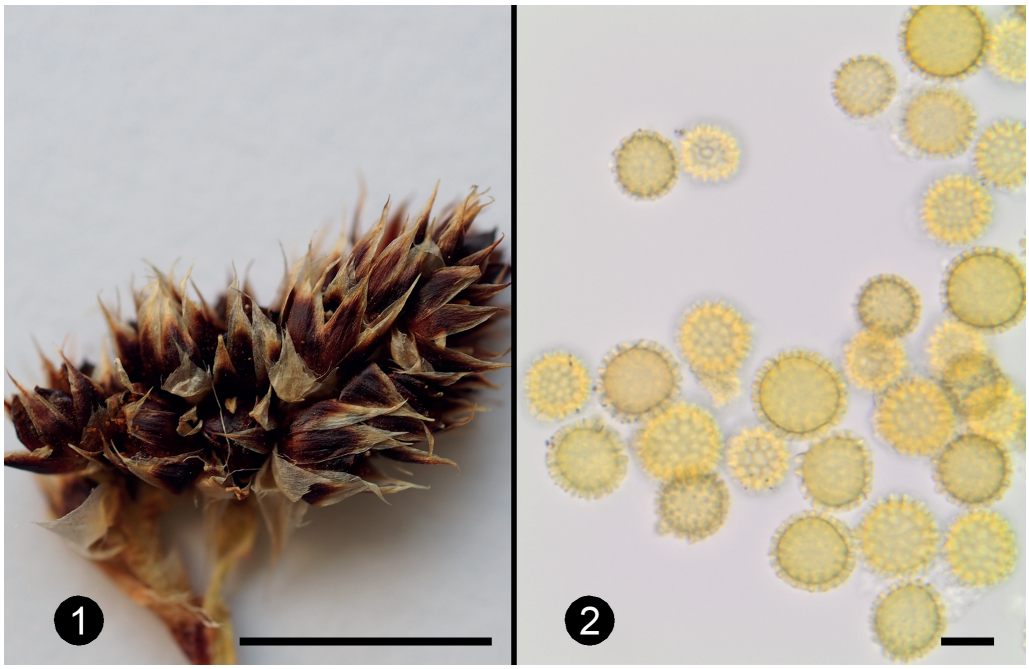
Dried specimens from C, GZU, MA, and W were examined under a light microscope (LM); spore balls of *Moreaua kochiana* were examined also under scanning electron microscope (SEM). For LM observations and measurements, spores were mounted in lactoglycerol solution (w : la : gl = 1 : 1 : 2) on glass slides, gently heated to boiling point to rehydrate the spores, and then cooled. The measurements of spores of *Bauerago vuyckii* are given as min–max (extreme values) (mean ± 1 standard deviation). For SEM, spore balls of *Moreaua kochiana* were attached to specimen holders by double-sided adhesive tape and coated with platinum in an ion sputter. The surface structure of spores was observed and photographed at 10 kV accelerating voltage using a JEOL JSM 6610-LV scanning electron microscope. The descriptions below are based entirely on the specimens examined. The shapes of spores and spore balls are arranged in descending order of frequency.

Taxonomy

Bauerago vuyckii (Oudem. & Beij.) Vánky, Mycotaxon 70: 46, 1999. ≡ *Ustilago vuyckii* Oudem. & Beij., Verslagen Zittingen Wis- Natuurk. Afd., Kon. Ned. Akad. Wetensch. 3: 55, 1895 (as '*Vuijckii*'). ≡ *Cintractia vuyckii* (Oudem. & Beij.) Cif., Ann. Mycol. 29: 72, 1931. — Holotype on *Luzula campestris,* the Netherlands, near Voorschoten, 22 May 1894, leg. L. Vuyck, s.n. (L). **Figs 1, 2**

Infection systemic. **Sori** in capsules, destroying seeds; spore mass pulverulent to semi-agglutinated, yellowish to orange. **Spores** subglobose, globose or broadly ellipsoidal, (14–)15–20(–21) × (13.5–)14.5–18.5(–19.5) (17.9 ± 1.2 × 16.7 ± 1.2) µm (n = 100), medium yellowish brown to medium reddish brown, reticulate, sometimes incompletely reticulate; spore wall (3.3–)3.6–4.4(–4.7) µm thick (including reticulum); meshes (4–)5–7(–8) per spore diameter, irregularly polyhedral, (1.0–)1.3–4.0(–4.5) µm long; muri 18–23 on equatorial circumference, in optical median view acute or subacute, (1.1–)1.3–2.3(–2.6) µm high.

Specimen examined – On ***Luzula alpina*** Hoppe (det. J. Kirschner): **AUSTRIA,** CARINTHIA, the Gailtal Alps, 46°42′53″N, 12°55′02″E, alt. 1940 m, 19 Jul 1998, leg. F.



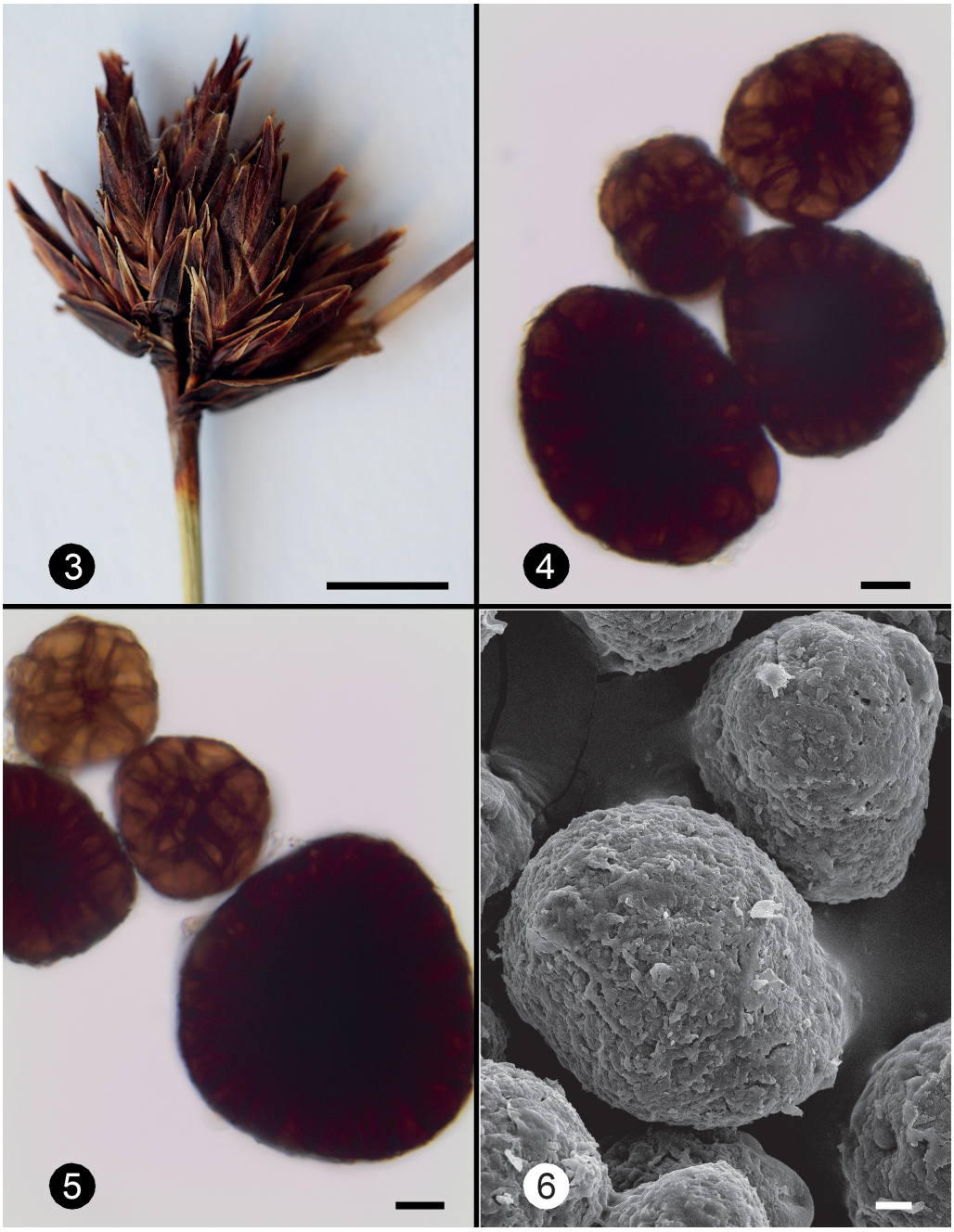
Figs 1, 2. *Bauerago vuyckii* on *Luzula alpina* (MA 693431). **1.** Habit. **2.** Spores in LM. Scale bars: 1 = 0.5 cm, 2 = 10 µm

Speta, G. Kleesadl & H.-P. Reinthaler, no. 1830, distributed by the 'Société pour l'Échange des Plantes Vasculaires d'Europe et du Bassin Méditerranéen', exs. no. 19840 (MA 693431).

Distribution – On *Juncaceae: Luzula alpina, L. campestris* (L.) DC., *L. glabrata* (Hoppe) Desv., *L. hitchcockii* Hämet-Ahti, *L. multiflora* (Ehrh.) Lej. subsp. *multiflora, L. multiflora* subsp. *frigida* (Buchenau) V.I. Krecz. (*L. frigida* (Buchenau) Sam.), *L. multiflora* subsp. *sibirica* V.I. Krecz. (*L. sibirica* (V.I. Krecz.) V.I. Krecz.), *L. novae-cambriae* Gand., *L. parviflora* (Ehrh.) Desv., *L. pilosa* (L.) Willd. (*L. vernalis* (Reichard) DC.), *L. piperi* (Coville) M.E. Jones, and *L. stenophylla* Steud. (*L. pseudosudetica* V.I. Krecz.); Europe, Asia, North America (Canada, U.S.A.), and Australia (Fischer 1953; Lindeberg 1959; Jørstad 1963; Hamet-Ahti 1972, 1982; Vánky 1985, 2011; Ginns 1986; Scholz & Scholz 1988, 2000, 2004, 2013; Karatygin & Azbukina 1989; Spooner & Legon 2006; Tomasi 2007, 2018; Mułenko et al. 2008; Vánky & Shivas 2008; Karatygin 2012; Klenke & Scholler 2015; Jage 2016; Farr & Rossman 2020).

Bauerago vuyckii is the only member of this genus with hosts in *Luzula.* This smut fungus is reported here for the first time from Austria (comp. Zwetko & Blanz 2004), on a new host plant, *Luzula alpina.*

Moreaua kochiana (Gäum.) Vánky, Mycotaxon 74: 352, 2000. ≡ *Tolyposporium kochianum* Gäum., Ber. Schweiz. Bot. Ges. 41: 179, 1932. ≡ *Thecaphora kochiana* (Gäum.) Thirum. &



Figs 3–6. *Moreaua kochiana* on *Schoenus nigricans* (W 2001-0009591). **3.** Habit. **4, 5.** Spore balls in LM. **6.** Spore balls in SEM. Scale bars: 3 = 0.5 cm, 4, 5 = 10 µm, 6 = 5 µm

Neerg., Friesia 11: 186, 1978. — Holotype on *Schoenus* ×*scheuchzeri* (as '*S. ferrugineus* × *S. nigricans*'), Switzerland, Kanton Zürich, at Greifensee Lake, June 1932, leg. W. Koch & L. Zobrist, s.n. (ZT). **Figs 3–6**

Infection systemic. **Sori** around filaments and gynoecium of all flowers of infected plant, concealed by adjacent glumes and outwardly inconspicuous; the mass of spore balls blackish brown, initially agglutinated, later powdery. **Spore balls** irregular, subglobose, broadly ellipsoidal or ovoid, composed of (2–)5–50 or more, firmly united spores, occasionally single spores present, (16.5–)21–70(–88) × (14.5–)18–55(–63) µm, dark reddish brown to very dark reddish brown or medium reddish brown when composed of few spores, opaque when composed of tens of spores. **Spores** in surface view irregularly rounded, irregularly polygonal, subcuneate, subglobose, elliptical or broadly elliptical, measured from the free side (5.5–)6.5–15(–16) × (5–)6–11(–12) µm; radially (5–)6–15.5(–17) µm long; wall 1.2–3.2 µm thick at free surface, 0.5–1.0 µm thick at contact surfaces. In SEM, spore wall rugose to irregularly verrucose.

Specimens examined.

On ***Schoenus nigricans*** L.: **AUSTRIA,** LOWER AUSTRIA, Gelber Berg near Purkersdorf, 0.9 km SE of Rudolfshöhe, 48°11′35″N, 16°12′01″E, alt. 315 m, 29 Jul 1999, leg. B. Wallnöfer, no. 13708 (C, MA 691763, W 2001-0009591).

On ***Schoenus* ×*scheuchzeri*** Brügger: **AUSTRIA,** VORARLBERG, wet meadows at Bodensee Lake, 6 Aug 1936, leg. H. Schaeftlein, s.n. (GZU 000323460; host plant as '*S. nigricans*').

Distribution – On *Cyperaceae: Schoenus carsei* Cheeseman, *S. nigricans,* and *Schoenus* ×*scheuchzeri* Brügger (*S. ferrugineus* L. × *S. nigricans* L., *Schoenus* ×*intermedius* Brügger); Europe (Netherlands, Germany, Switzerland, Austria, and Italy) and New Zealand.

Moreaua kochiana has been previously recorded on *Schoenus nigricans* from the Netherlands (Ernst 2013) and Italy (Vánky, *Ustilaginales* Exsiccata, no. 861), on *Schoenus* ×*scheuchzeri* (as '*S. ferrugineus* × *S. nigricans*' or '*Schoenus* ×*intermedius*') from Switzerland (Gäumann 1932; Thirumalachar & Neergaard 1978; Vánky 2000; Vánky, *Ustilaginales* Exsiccata, no. 189) and Germany (Kruse et al. 2014), and on *S. carsei* from New Zealand (McKenzie & Vánky 2001). It was also recorded on three species of *Schoenoplectus* (Tomasi 2014), but the association of these plants with *M. kochiana* needs re-examination. This smut fungus is reported here for the first time from Austria.

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